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SCIENTIFIC AMERICAN

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IN THE AFTER OBSERVATION SALON OF THE TRANS-ATLANTIC DIRIGIBLE.—[See page 400]

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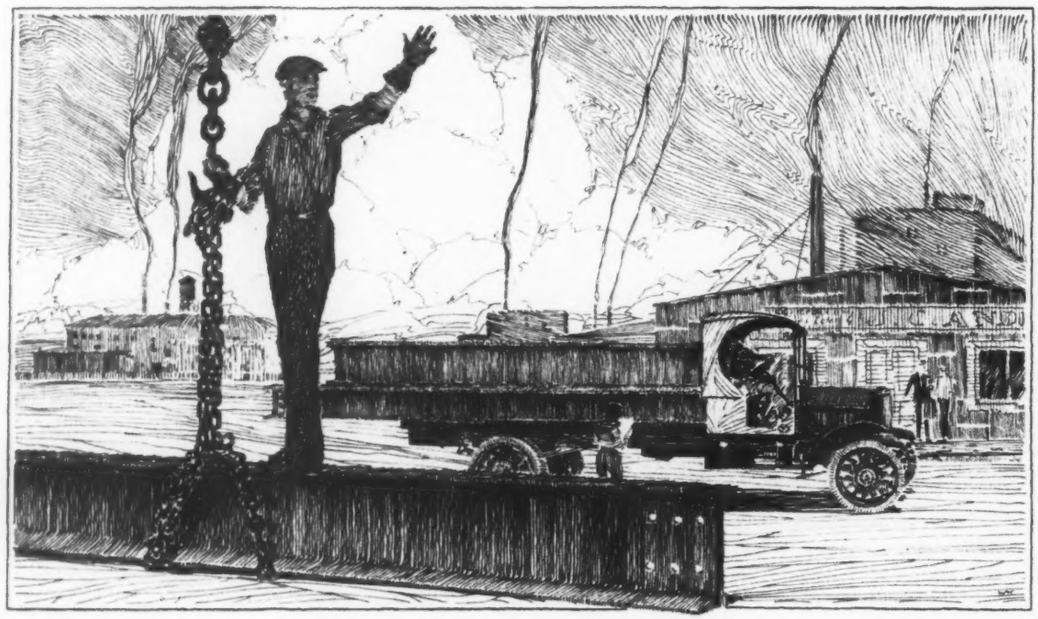

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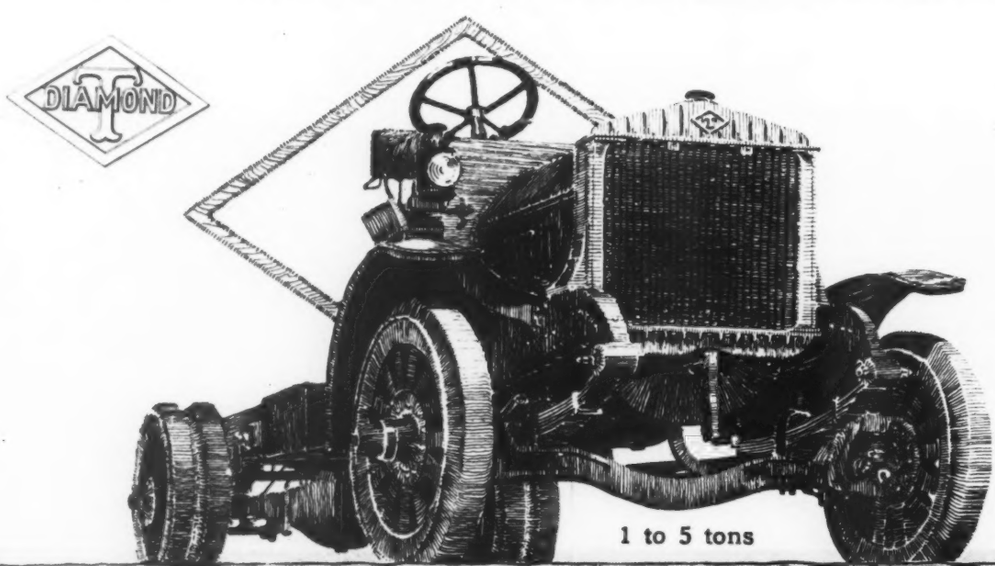

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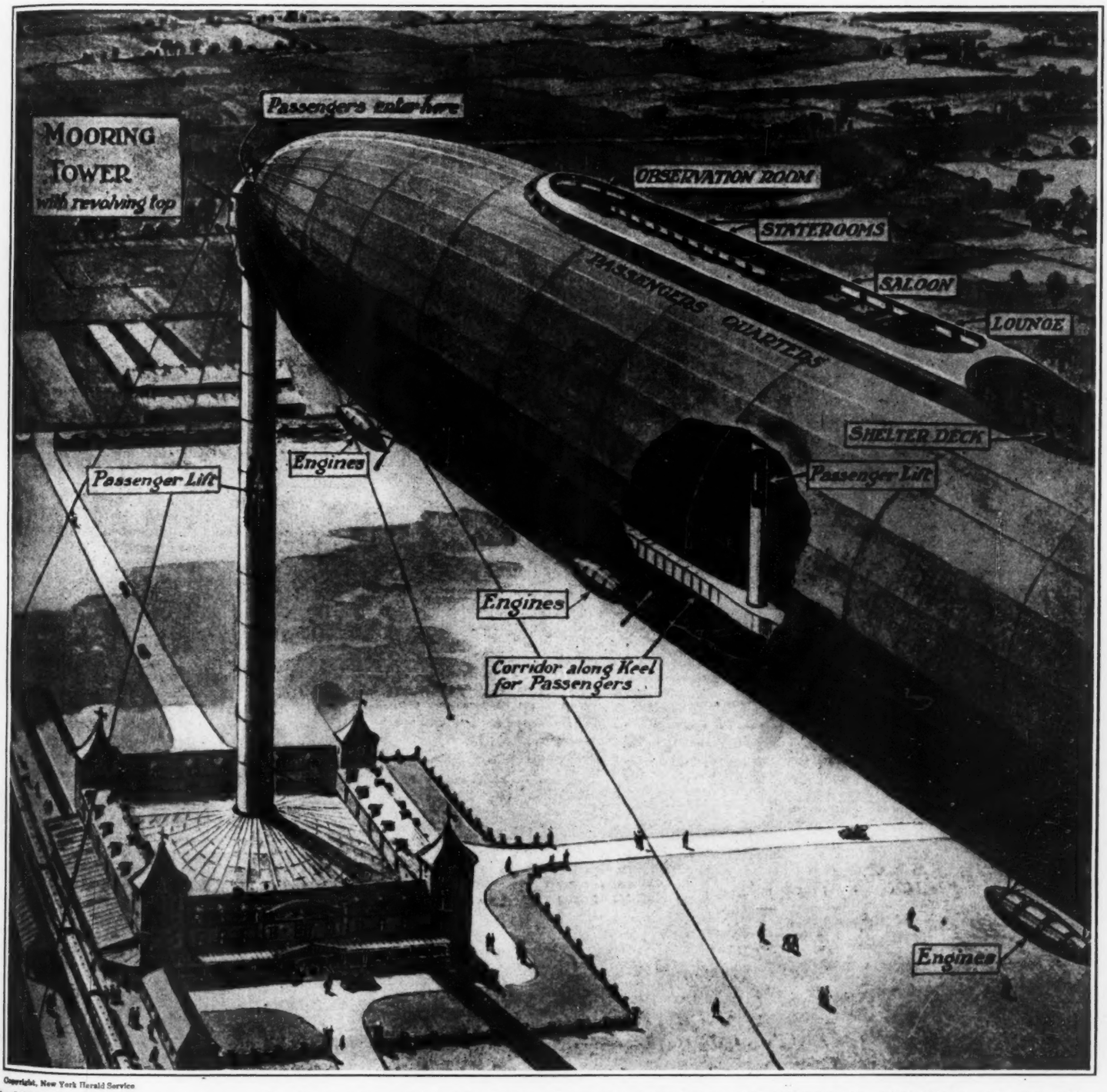

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Mooring-out tower arrangement proposed for the huge trans-Atlantic rigid dirigibles, showing the salient features of the landing station and the airship.—(See page 400)

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How Big Is Our Merchant Fleet?

THE country is following with deep interest the upbuilding of the United States Merchant Marine. If it is not, it should be; for there is no great industrial effort of the day that compares with this, either in its present magnitude or its future possibilities. The absence of our merchant flag from the high seas has been a source of amazement to the American traveler for many a decade past, and a cause for deep concern to the shipping men of the country. For the possession of a great merchant fleet is something more than a valuable commercial asset: it is a source of proper patriotic pride, as a visible expression on all the seven seas of the enterprise, wealth and power of the country whose flag it flies.

So the awakened interest of America in its merchant marine is most fortunate and should be stimulated by every proper means. Unfortunately, the way things are going, it is impossible for the average citizen to understand" just what progress we are making relatively to the other ship-owning nations. This bewilderment is due to the fact that the Shipping Board talks of its tonnage in one language and the rest of the maritime world in another; and, as it so happens, the difference is such as to lead the American public to believe that our fleet is 50 per cent larger than it is in comparison with those of other nations.

The Shipping Board speaks of its ships in "deadweight" tons; whereas the whole maritime world always has and does now speak in terms of "gross" tons. Now a gross ton is about fifty per cent larger than a deadweight ton, and unless it is borne in mind that tons in Shipping Board nomenclature means deadweight tons, and a subtraction of one-third be made in comparing our total tonnage with that of the rest of the world, we shall have a greatly exaggerated idea of what is being accomplished.

Thus, if we are told that our total tonnage, deadweight, is, 9,200,000 tons, and then, find in some shipping journal that the world's total is, 37,000,000 tons, we shall jump to the false conclusion that we own one-fourth of the world's shipping. As a matter of fact we own but one-sixth; the 37 million tons of world shipping, being expressed in gross tons, is equal to over 55 million tons deadweight.

The use of the term deadweight is due to the fact that the Shipping Board made its contracts in deadweight tons (as often happens in the case of large ships) and it was, in fact, unable at the time to make its announcement of what it was going to do in any other terms. Possibly the Board adopted its present nomenclature somewhat for the effect the larger totals would have in discouraging the enemy. Now that peace conditions have come, the Board will surely adopt the terms which are in universal use throughout the maritime world.

The Advent of Colloidal Fuel

WHAT are we going to do when our oil wells run dry? And dry they certainly will run in the near future unless our geologists are woefully in error. We have used up 40 per cent of our native supply of petroleum, so says Franklin K. Lane, Secretary of the Interior. Between 1859, when petroleum was first discovered in Pennsylvania, and 1917 we drew from our underground reservoirs a total of 42 barrels per capita, based upon a present population of 100,000,000. Today, there are left in reserve for each of us a mere matter of 70 barrels. The prospect is disquieting, because we are draining Nature's supply with increasing volume each added twelvemonth.

For our newly-created merchant marine we shall need about 32,000,000 barrels of fuel oil in the ensuing year, and our fighting fleet will consume in that time a round 4,000,000 barrels. These are merely straws which show the trend of the current of consumption. Quite half of all the petroleum mined in this country is used for steam raising, and there are parts of the United States today wholly dependent upon liquid fuel. Crude oil and petroleum derivatives are indispensable to our industrial progress and to our many other manifold activities.

The scientists are no less insistent that anthracite coal is a luxury and that Nature has made it distressingly plain that this fuel will cease to be available here in the next forty or fifty years. Be this as it may, it is indubitably true that there are many millions of tons of anthracite screenings, technically known as culm and "rice," of which we make precious little use; and, similarly, there are enormous quantities of waste from our bituminous coal fields which would render excellent service in steam raising if made fit for firing in the average furnace. Finally, there are by-products of the oil refineries which are susceptible of furnishing motive energy. How, then, can we utilize these various industrial by-products and turn them into commodities of prime importance—thus, possibly, staving off the day of a liquid fuel shortage?

Happily for us, the Submarine Defense Association, largely through the investigations of its engineer, Mr. Lindon W. Bates, has answered this momentous question. Thanks to their combined efforts during the war to produce a smokeless fuel and to safeguard our Allies from a shortage of vitally necessary fuel oil, they have evolved a combination of oil and pulverized coal, etc., which is termed colloidal fuel. This source of energy can be fed to the burners of any existing oil-burning equipment, and does not call for change of installation of any sort. In just that measure in which powdered coal, tar, ground coke, etc., is added to each gallon of the liquid fuel a like quantity of oil is dispensed with, and yet the total value in heat units is actually augmented.

To make this practicable many months of laboratory research were required to discover a medium which would neutralize gravitation and keep the introduced heavier particles of carbon from settling and calling for some special apparatus to stir up the mixture just before drawing it from the tanks for burning. The new agent is a paste-like greasy substance, called "fixateur." Twenty pounds of this stuff in a ton of liquid fuel keeps the powdered coal and tar suspended in the oil and evenly distributed throughout its volume.

As a result of this seeming annulment of one of Nature's laws, it is possible to combine in a stable liquid fuel 45 per cent of oil, 20 per cent of tar, and 35 per cent of pulverized coal, thereby replacing over one-half of the oil, securing equal or greater heat values per barrel, and saving considerable in cost. In fact, grades of colloidal fuel can be prepared which, upon a given tank capacity, will give warships or merchant vessels a 20 per cent increased steaming radius over that possible with the usual fuel oils. All the fuel pastes are mobile to sustained and easily applied pressure and may be thus pumped, fed and atomized in the combustion chamber.

This achievement makes it practicable to commingle the waste products of the mine, the gas-house, and the oil refinery and thus to cut down to a large extent the present consumption of fuel oil. As one result of our effort to neutralize the grim activities of Teuton U-boats, we now have offered us a potential economic boon of enormous value.

Science and Utility

THE ancient Greek took what science he possessed as a mental recreation altogether. He pursued his geometry, not with any idea that it was or could be made of practical use, but solely because it appealed to his intellect. Indeed, he went further than this; he actually frowned upon its practical use, as profanation of a high and holy thing; and in the rare event that such profanation became a practical necessity, he placed it in the hands of his slaves, so that at least his own mind might not be degraded by the shameful contact between the beautiful world of thoughts and the commonplace, ugly world of things.

Today we seem universally inclined to push to the other extreme. Nothing is worth doing on its own grounds, without consideration of its practical bearing. Even physical exercise, in which we indulge with an enthusiasm duplicating if not actually exceeding that of the Greek himself, is apologized for as a means to the altogether praiseworthy end of keeping us in physical condition to do more work and better work in our working hours. As for mental exercise or mental recreation—this, to the utter dismay of the classicists, is a lost art.

Most of us do not attempt it at all. Some of us pretend to partake of it, but turn such participation into a commercial side-line—a means to make spare time pay cash dividends, under the more or less plausible plea that the change of work affords an enjoyable relaxation from our regular occupation. And those of us who really do pursue a mental recreation without hope of financial advantage bring to it the same intensity that characterizes our real vocations, so that the professional zoölogist or conchologist or some-other-kind-of-an-ologist counts himself fortunate indeed if he can keep up with the amateur who follows the line only as a hobby.

We do not know whether all this is to be counted as an advantage or as a disadvantage in casting up the account for and against the modern viewpoint as to what is and what is not worth doing. Certainly there are advantages, even if this be not among them. In particular, there is the paramount advantage for which we are really striving more or less consciously, that what we do really gets done with more effectiveness than it otherwise would. The Greek, intellectually, was our equal—perhaps even our master. Yet he never set up a civilization that amounted to anything in any other direction than the artistic, simply because he never could be induced to bring to bear upon each other the facts of everyday life and the things which he knew or thought he knew. It is in our ability to work out this correlation that we may find the key to modern progress. And it is clear that to our insistence that all things pay their way we can directly trace the current partnership between the man who knows and the man who does.

This insistence can be seen on every hand. The merest school child claims the privilege of deciding, on strictly utilitarian grounds, what shall be taught him, of rejecting or at least ignoring every scrap of schooling whose utility cannot be demonstrated. The decision between French and German and Spanish hinges on the question of which will be of immediate commercial value. The case of college vs. business is adjudicated on a hard basis of dollars and cents and finally, in the rare event that the student turns out to be one of those strange souls with a penchant for advanced research, the first question that he meets in the mouths of the laity, as he produces a new fact or a new theory or a new substance or a new element of any description, is "What can you do with it?"

The answer to this question is always pertinent, and usually interesting. Its pertinence and its interest increase with the apparent complexity of the subject, and the apparent improbability of its ever attaining a basis of practical use. As a case in point, we may take the article in this week's SUPPLEMENT on ultra-violet energy and its commercial application. The notion of using invisible light in his business will intrigue the layman much in the same manner as did the same notion with regard to X-rays and wireless waves.

To Our Subscribers

OUR subscribers are requested to note the expiration date on copies of SCIENTIFIC AMERICAN. If they will send in their renewal orders at least two weeks prior to the date of expiration, it will aid us greatly in rendering them efficient service.

Aeronautical

Air Service Casualties in A. E. F.—The War Department has recently announced that during the aerial fighting at the front, the American Air Service suffered 554 casualties as follows: Killed in action, 171; prisoners, 135; wounded, 129; missing, 73; killed in accidents, 42; miscellaneous, 4. The number killed in action is over a third of the casualties. During the month of September 181 casualties were reported.

Government Sales of Planes and Equipment.—The War Department authorizes the following statement from the Office of the Director of Sales: Sales reported to the office from March 8th to March 14th, inclusive, include the following Air Service equipment: Airplanes, $319,000; airplane equipment, $679,887. These figures are interesting in view of the vast amount of aerial equipment which the Government has for sale in the process of reducing the Air Service to a peace basis. All materials sold by the Director of Sales aggregated $42,499,827 within the time covered by the foregoing.

London-Cape-Town Air Flight.—During the next few months the British Air Ministry propose an experimental flight from London to Cape Town. Exploration parties are out on the road fixing upon stops and petrol stations, which as far as can be arranged, will be about 400 miles apart. The route selected will probably be: London, Paris, Marseilles, Naples, Crete, Egypt, Nile Valley, Northern Rhodesia, Victoria Falls, Johannesburg and Cape Town, a distance of some 7,800 miles. It is expected that a Handley-Page machine similar to that which carried General Salmond from Egypt to India will be used.

Flares for the Trans-Atlantic Fliers.—Flame and smoke flares developed during the war and improved recently by chemical experts of the army will be employed in the coming trans-Atlantic flight efforts of our naval airmen. It is understood that our airmen will drop these flares at intervals, so as to determine the drift of their planes in the cross winds and to make the corrections necessary to keep them on their course. The flares are so constructed that they ignite upon touching the water. By day they may be seen by means of the column of smoke, while at night they can be detected by their bright flame.

Our Air Service for Peace.—According to the latest available information, it is understood that the Army reorganization plans upon which the War Department is now working call for approximately 1,700 airplanes in actual commission and a minimum available reserve of 3,400 additional planes. This is based upon the proposed military establishment of 509,000 men, in which total the air service personnel will be 1,923 officers and 21,853 men. There are to be 87 service squadrons, of which 42 will be assigned to coast defense work in the United States and insular possessions; 20 will be pursuit squadrons and 25 observation and bombing squadrons. The typical Army airplane squadron includes 18 planes in service and their personnel. Of the observation balloons, it is understood that there are to be 42, divided into three wings of 14 companies each.

What Are the Military Airmen Going to Do?—Now that the war is over, there are thousands upon thousands of airmen with nothing to do. They have been returned to civilian life within the past few months. Some of them have already gone into their former occupations, while others are still undecided. But how do they feel toward flying as an occupation or a sport? That was the question recently asked of a group of demobilized airmen in one of the leading New York clubs. One airman, who has done good work in the war, stated that when he landed from his last flight in France, he swore he would never again leave the ground. He confessed that he had flown purely as a military duty, and not as a sport. Another airman, while feeling the same way at first, began to long for an airplane after being in civilian life for a few months. At last accounts he was going about soliciting employment with American aircraft organizations as an airplane tester or exhibition pilot. Still another airman felt that there was nothing to commercial aviation in the immediate future, in the United States, at least, and that as a sport it was far too expensive for his pocketbook. As a general thing, the vast majority of former military and naval pilots are seeking fields other than aviation for their future efforts.

Astronomy

The Latest Astronomical "Bull."—We are again indebted to the French journal *l'Astronomie* for rescuing from oblivion a delightful example of newspaper astronomy. A writer refers to "the interest which enables an astronomer to sit up all night to watch a transit of Venus." This remark appears in no less a place than the Educational Supplement of the London *Times*.

The Star of Highest Known Radial Velocity.—From the spectroscopic measurements made at Mount Wilson Observatory to determine the radial velocity of stars (*i. e.*, the speed with which they are approaching or receding from our solar system), it appears that the star A. G. Berlin 1366 has a radial velocity of 339 kilometers per second, the highest constant velocity so far observed for any star. Next to this comes Lalande 1966, with a velocity of 325 kilometers per second, in the opposite direction.

A Method of Determining the Diameters of Heavenly Bodies from a study of their interference fringes is described by Maurice Hamy in the last Annuaire of the Bureau des Longitudes. The author shows how this method may be applied to measurements of such bodies as satellites and minor planets and gives determinations for several of these bodies. He expresses the opinion that with the new 100-inch reflector at Mt. Wilson it might be possible to measure the angular diameters of first magnitude stars by this method.

A "Prominence" on Jupiter.—A bright protuberance, apparently analogous to a solar prominence, was observed on Jupiter last January by Mr. F. Sargent, of Bristol, according to a note in *Nature*. It was situated on the equatorial side of the north equatorial belt, and when first seen, about 9 P. M., January 16th, was on the eastern edge of the planet. With the rotation of the latter it could be seen as a white spot, which grew fainter as it advanced farther on the disk, until clouds prevented further observation. The following night it was seen at 6.46 on the central meridian, though so faint as to be barely perceptible. At 9.05 P. M. it was seen as a bright projection from the western limb.

Can the Corona Be Observed Without An Eclipse?—So many "impossible" things have been done by astronomers that it would be rash to assert that no means will ever be found of observing the solar corona except during a total eclipse. Some hopeful experiments in this connection have recently been made at Mount Wilson Observatory and are still in progress. Director Hale states that two methods of detecting the corona in full sunlight were tried by him many years ago. One involved setting the second slit of a spectroheliograph on the center of a dark line of the solar spectrum. This would produce a reduction in the brightness of the sky without diminution in the light of the corona, as the latter is assumed to be derived from a continuous spectrum. The other method consisted of attempting to measure with a sensitive bolometer the relative radiation of the coronal streamers and the sky between them. Neither plan was successful. At the total eclipse of June, 1918, Dr. Stebbins obtained, with a potassium photo-electric cell, large deflections corresponding to the total radiation of the corona (probably including the chromosphere and prominences). Professor Hale was thus inspired with the idea of using the photo-electric method in full sunlight, and accordingly experiments have since been made at Mount Wilson, by Ellerman, with two photo-electric cells exposed to the sky at points equidistant (about two minutes of arc) from the sun's limb. The cells are connected with an electrometer in such a manner as to give deflections corresponding to the difference in radiation received by them. If one cell were directed toward a coronal streamer and the other toward the sky between two streamers, the radiation would be unequal, and it was hoped that by this means the difference due to the added radiation of the corona might be detected. Unfortunately continual small fluctuations were found near the sun, making the measurement of very small differences impossible, but the work will be continued with improved apparatus. Professor Hale thinks it barely possible to send up balloons, carrying photographic apparatus, directed toward the sun by a gyrostat and controlled automatically by the heat of the sun's image, to a height sufficiently great to get rid of the atmospheric glare around the sun and allow the corona to be photographed without an eclipse.

Automobile

Tire Mileage Helps Sell Cars.—Tire trouble and tire expense still loom large to the owner or prospective owner of a car, and many a man is convinced that the car would be all right if tire vexations could be avoided, or at least minimized. One car manufacturer meets the situation by informing its purchasers and prospective purchasers that they can expect to cover 15,000 miles on a set of tires. Before doing this the company went exhaustively into the records of their cars and found that in some cases individual machines had made as much as 21,000 miles on a set of tires. The good records made are ascribed to the smooth running of the eight-cylinder engine, and the scientific distribution of weight.

Circumventing Car Thieves.—After considerable consideration and discussion the National Automobile Chamber of Commerce has come to the conclusion that there is no such thing as a lock that will absolutely prevent the stealing of an automobile; the best that can be looked for, it was believed, is so much trouble for the would-be thief that he will be discouraged because of the chances of detection while trying to circumvent the lock. The consensus of opinion was that the best kind of a lock is one that locks the gearset and the next the lock that prevents the use of the steering gear. The suggestion was made that a bill of sale containing a complete detailed description should be given to the purchaser of a car, to be transferred in case of the transfer of the car to a new owner, this document furnishing means for identifying the machine in case of theft.

Highway Transportation Being Readjusted.—The sudden decline in the demand for the transportation of merchandise has proved a hard blow to many concerns which during the war did a huge business over the roads. Large fleets, in some cases, have been practically put out of commission. Some of the truckmen are reorganizing their business and altering their plans to suit new conditions, which are normal conditions. Smaller concerns are going out altogether. This is by no means an unhealthy sign; it indicates simply that abnormal conditions have ceased to exist. The end came so suddenly that practially all were unprepared. With some warning adjustment could have been made; but the warning was lacking. The readjustment period is an uncomfortable one for many, but it is believed that the trucking business will come through it in good shape.

Cooling System Precautions.—With the approach of warm spring weather, motorists who have been using mixtures of denatured alcohol and water in their automobile cooling systems during the past winter as an anti-freezing solution should be careful to reduce the proportions of alcohol to a low point and run strong percentages of water. If the proportion of alcohol is too great, the low boiling point of the cooling mixture will result in overheating of the engine. As there is still a chance for a cold snap or two during April, the alcohol should not be completely removed, but a 15 per cent mixture will give ample protection. If anti-freezing solutions including calcium chloride or other soluble salts have been used, the motorist should flush out the cooling system thoroughly with water under city pressure to wash out any crystals or incrustation in the water-jackets or radiator tubes due to evaporation of the water and consequent increase in salt proportions, before the coming of real warm weather.

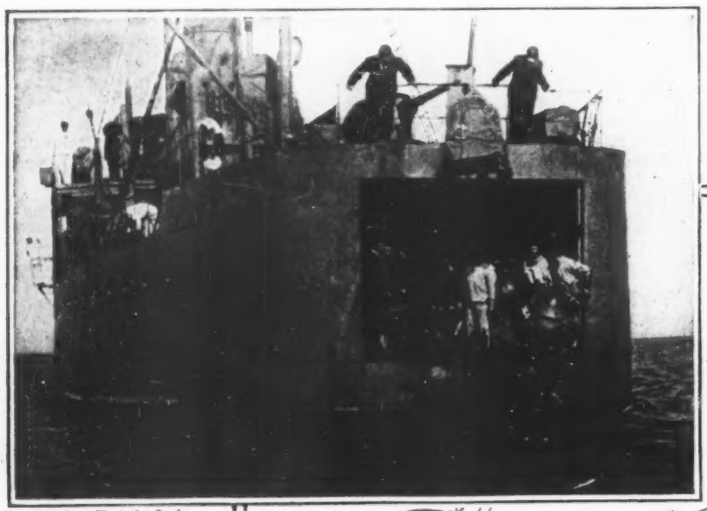
New Steel Wheel.—A Philadelphia manufacturer is producing a steel wheel for automobiles that looks very much the same as a wooden wheel. It is built up construction but is simpler than the usual forms because there are but few welds and these are easy to make. It is believed that a wheel of this nature can be made as light as a wooden wheel of the same size and be very much stronger and not subject to deterioration or damage as the wheel of less resisting material would be. Each of the shanks or wedge ends of the spokes are steel castings, but these could be drop forgings and it is possible to make them either individually or to cast or forge the whole set in one integral portion. The tubular steel spokes are welded in place and the nipple at the upper end which secures the felloe is afterwards peened over so as to hold the rim absolutely. The felloe is of a rectangular box section and the tire carrying rim is, of course fitted outside this. As the wheel looks exactly like a wooden one the motorist of conservative tastes cannot object to it because it is unconventional in appearance.

Floating Mines in the North Atlantic and Arctic Oceans

Trend of Ocean Currents in Relation to Dangers to Navigation from Mines Which Have Broken Loose from Their Bearings

By His Highness. Albert. Prince of Monaco

THE waters of the North Atlantic are seriously affected as regards the displacement of their superficial mass by the current of the Gulf Stream, whose course I have long made a subject of study. I distributed over certain areas of the ocean, a large number of objects made of wood, metal or glass, and so constructed as to float just below the surface in order that they might avoid the direct action of the wind, while at the same time being exposed to that of the current which displaces the mass of the water. The floats of which I have made use in this vast experiment traversed the Atlantic Ocean for a score of years—some of them indeed have been quite recently encountered.



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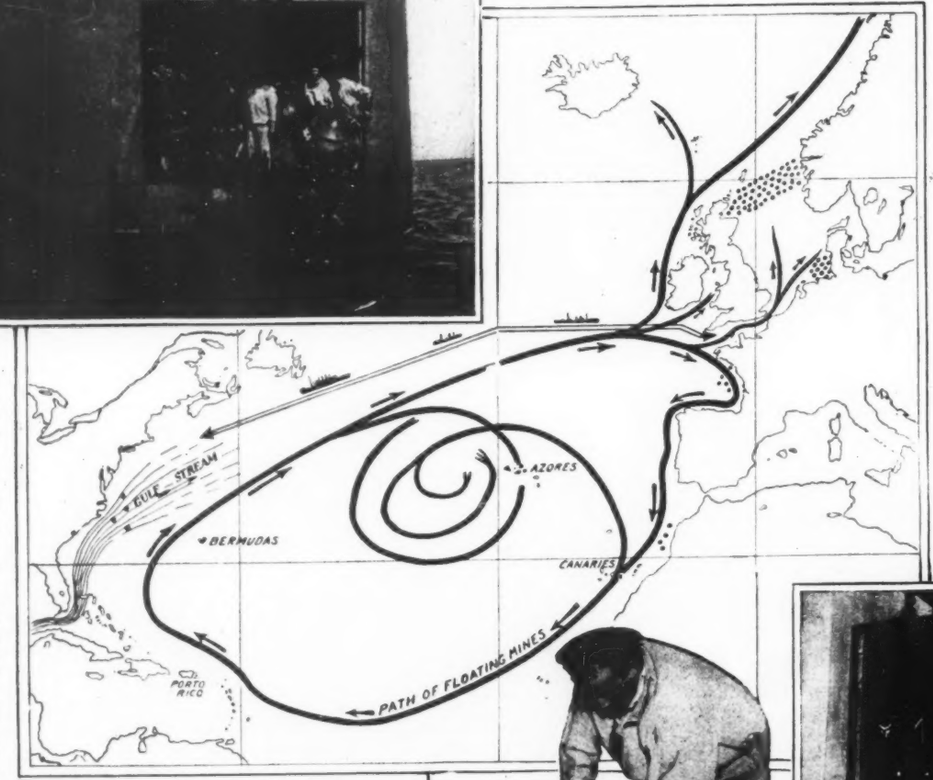
Dutch mine sweepers clearing the North Sea

There is a certain analogy between these floats and the floating mines employed during the Great War which enables us to make use of similar methods in calculating the course of travel of the latter; it is possible, however, that the mines move more slowly than the floats because of their greater mass. Floating mines, however, expose navigation to a very considerable degree of danger which continues so long as they remain afloat. And it is quite certain that a number of them have escaped from the fields where they were moored. The war between Japan and Russia furnished examples of catastrophes arising from the fact that the travel of these wandering bodies was not arrested by the end of hostilities.

Since it would scarcely be possible to recover these mines throughout the immense extent of the ocean, it becomes necessary, in order to give comparative security to navigators, to study and point out the quarters towards which they move as carried by one current or another, according to their point of departure. The long course of my oceanographic researches has provided me with the knowledge required for the solution of this problem, and has enabled me to prepare the accompanying chart, showing the results obtained. Mines whose point of departure is located in the North Sea may wander along the French, Dutch, Belgian, Danish or East English coasts until they finally penetrate into the fjords of Norway. Those which start from the English Channel may wander at first back and forth between the French and English coasts under the influence of the tides or of some chance storm, but all of them find their way at last into the ocean, some of them to follow the course of the Gulf Stream toward the south, the others to join those which after starting from the coasts of Ireland or from the Irish Sea have traversed the Arctic Ocean and finally reached the coast of Norway.

Those mines which started from the French, Spanish, Portuguese and Moroccan coasts of the Atlantic, as well as those whose point of departure was in the Canary Islands, Medeira, the Antilles, the Bermudas, or the Azores have entered the great system of oceanic circulation. This circulation is set up by the influence of the Gulf Stream and my previous studies concerning it have proved to be exact in their data, not only as regards the direction pursued but also with respect to the speed of travel. According to my researches the mines set free from their moorings along the cost of Europe and that of Africa, from the English Channel to the northern extremity of the Canary Islands, have entered by degrees into the equatorial current, after having traveled toward the south and coasting along without touching the northern shores of the Cape Verde Islands, exhibiting at the same time a trend toward the west. Thereafter, borne toward America by the said equatorial current, they visited the Small and Great Antilles as likewise the Bahama Islands, coasting especially along the eastern region of these archipelagoes. However, they sometimes travel by accident as far even as the coast of Central America without having entered the Gulf of Mexico. Shortly afterward they again pass into the current of the Gulf Stream at its exit from the Gulf of Mexico, exhibiting a tendency to remain upon the eastern edge, which enables them to visit the Bermudan Archipelago and arrive at that of the Azores.



Ocean currents of the North Atlantic showing the probable path of drifting mines

In the central area of the oceanic whirlpool formed by the Gulf Stream, whose axis revolves somewhere in the region southwest of the Azores, by far the greater part of these mines which have come from the Antilles must circulate indefinitely, according to the law which regulates the course of the flotsam in that part of the ocean, known by the name of Sargasso Sea.

After having floated thus for a greater or less distance along the northern, the southern, the eastern, and the western shores of the Archipelago of the Azores, but without ever traveling far beyond the 50th degree of latitude toward the north and the 15th degree of latitude toward the south, and without entering the cold current to the west which bathes the eastern shores of the United States these floats coming from the west arrive in the offing of the English Channel, near their point of departure, after having traversed the greater portion of the space which separates the Azores from the European continent. They then start out afresh on their travels along two routes. The first of these, which carries them toward Africa, causes them to enter the great cycle of the oceanic whirlpool where they circulate indefinitely. The other path takes them towards the northeast and distributes them plentifully along the western shores of England and of Ireland. All mines which take this latter road mingle in the fjords of Norway with those coming from the North Sea, finally reaching the Arctic Ocean somewhere near the North Cape, where they are doubtless destroyed upon their first contact with icebergs.

Some few, which may have left the coast of Great Britain somewhere near the Hebrides and visited Iceland doubtless also have disappeared among the floating ice along that coast. I do not know whether it is a fact that a few mines coming from the west have managed to penetrate into the North Sea by the English Channel, but this is possible.

Such mines as may have been planted along the coast of the United States must have entered into the great cycle of flotsam after having been caught by the

A mine anchor of the type that automatically regulated the depth of the mine

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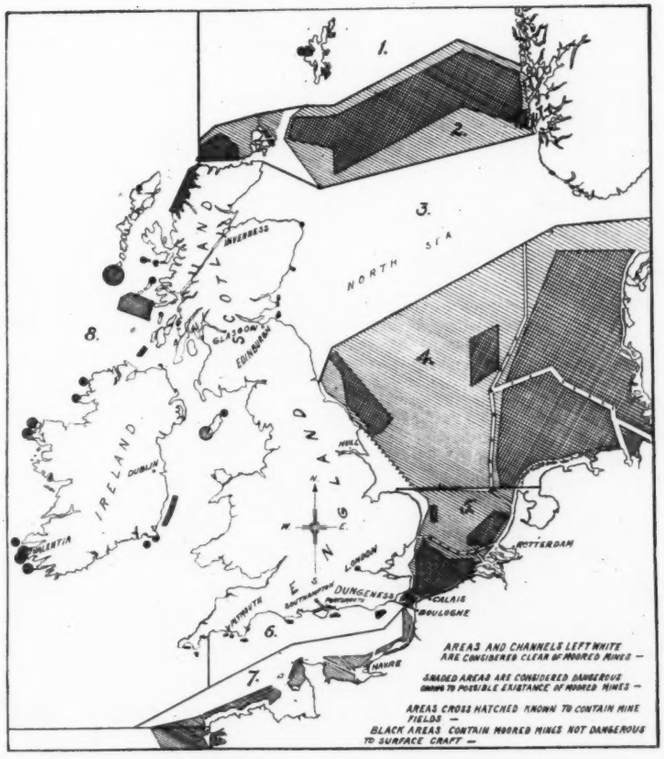
Turning the safety lever that makes the mine safe to handle

narrow polar current which descends from the north and follows this coast nearly down to the entrance to the Gulf of Mexico.

I have calculated the speed at which such bodies as these mines move from place to place, employing data obtained in my previous experiments with flotsam. The conclusions thus arrived at are as follows: The mines which leave the English Channel with the oceanic whirlpool as their destination travel toward the south, reach the Spanish coast near the lower part of the Bay of Biscay in the course of about two months. After leaving these "parkways" they double Cape Finisterre and continue to be driven towards the south along the coasts of Portugal and of Morocco, reaching the Canary Archipelago 10 months after their departure from the Channel.

Three years after making their original start and without counting a certain amount of time lost while passing through the Canaries, the mines have succeeded in crossing the Atlantic within a zone wherein are found the equatorial current, the current of the Gulf Stream and the current which gives birth to the trade winds. A considerable number of them succeeded thereafter in reaching the Antilles, especially the Archipelago of the Bahamas traveling at a speed of 10 miles per 24 hours.

And those mines which do not then become detached from the great swarm which have arrived at the entry of the English Channel and ascend towards the fjords of Norway after having circled Ireland upon the east and upon the west, commence anew their voyage around the Atlantic along the same path as the first. The average speed calculated as required for the accomplishment of this cycle by the mines is five miles per 24 hours.



This map shows why the German high seas fleet spent so much time studying the skyline of the dockyard buildings at Wilhelmshaven

The floating mines placed in the Mediterranean are not susceptible of having their course predicted except in a very small area situated between Gibraltar and the upper portion of the Balearic Isles, whither the general currents carry the waters of the Atlantic while the counter-currents carry them towards the west, along the coasts of Spain and of Africa.

As for the mines which have broken loose along the eastern coast of the United States, they have been captured by the cold current which loses itself in the Gulf Stream near its point of origin, at its exit from the Gulf of Mexico, and have thereafter entered into the general circulation here described.

While the data given above show the principal lines which are most dangerous to navigators because of floating mines, I cannot guarantee navigation against individual mines which may have been carried outside these general lines by storms.

It is possible that the mines in question may float in the Atlantic for a very long time, since my experimental floats have done so for a quarter of a century; the best means, therefore, of avoiding catastrophe from them is to direct the course of navigation so that it will lie as far as possible outside the cycle traversed by these dangerous engines of war. This cycle causes them to pass and repass among the archipelagoes scattered throughout the Atlantic Ocean; it is even possible that large numbers of them collect around these islands attracted by a special force and may be retained, for a longer or shorter time, by the influence of the tides and of local currents until carried again into the general circulation by the influence of certain winds. Little by little, of course, they will disappear through the explosions produced by their chance encounters with some other piece of flotsam or with the rocks along the coast.

The regions most subject to visitation by these mines may be enumerated as follows: The inner and southern portions of the Bay of Biscay, between Bordeaux and Cape Finisterre; the western coast of Portugal, that of Morocco and the archipelago of the Canaries, as also Madeira; the area included between the English Channel and the Canaries is particularly dangerous, because the winds which dominate this portion of the Atlantic exert a certain influence upon the transportation of the superficial stratum of the waters, and assist in driving the flotsam of the high seas toward these coasts. Between the Canaries and the Antilles the area visited becomes wider; in the sea surrounding the Antilles the mines are both more widely scattered and more apt to be destroyed because of being driven against rocky reefs. The return towards Europe of those mines which have failed to be destroyed is along a narrower path until the Archipelago of the Azores is reached; at this point there is fresh danger of collision because of the accumulation of flotsam similar to that in the Sargasso Sea which is produced here by reason of the fact that this is the central area of the whirlpool occasioned by the combined influence of the Gulf Stream and the equatorial current. The accumulation of floating mines, which are especially numerous at the center and along the periphery of the cycle they follow, has been augmented by the continual escape of these engines of destruction during the last four years.

The ships which travel back and forth between Europe and the United States will find their greatest safety north of the line which runs between the entrance to the English Channel and 50 degrees of latitude north, and by following this as far as 30 degrees of longitude west, afterward turning downwards toward the southern coast of the Banks of Newfoundland. The waters of the warm current flowing from America toward Europe probably mark the northern limit of the dangers which may be encountered.

It may be stated in general that the ships which travel between the southern portion of Europe and the United States will encounter their greatest risks in the vicinity of the coasts of Europe and of the Archipelagoes as far down as the southern portion of the Canary Islands, and will find their safest course of travel along the line passing a little bit to the north of Madeira and following a tangent along the southern edge of the Sargasso Sea.

From the same point of view the central region of the North Atlantic, between 32d degree and 43d degree of north latitude and between 24th and 50th degrees of west longitude (Greenwich) will be the most dangerous area. The danger of encountering a still active mine may continue for a long period of time, since the simple floats utilized

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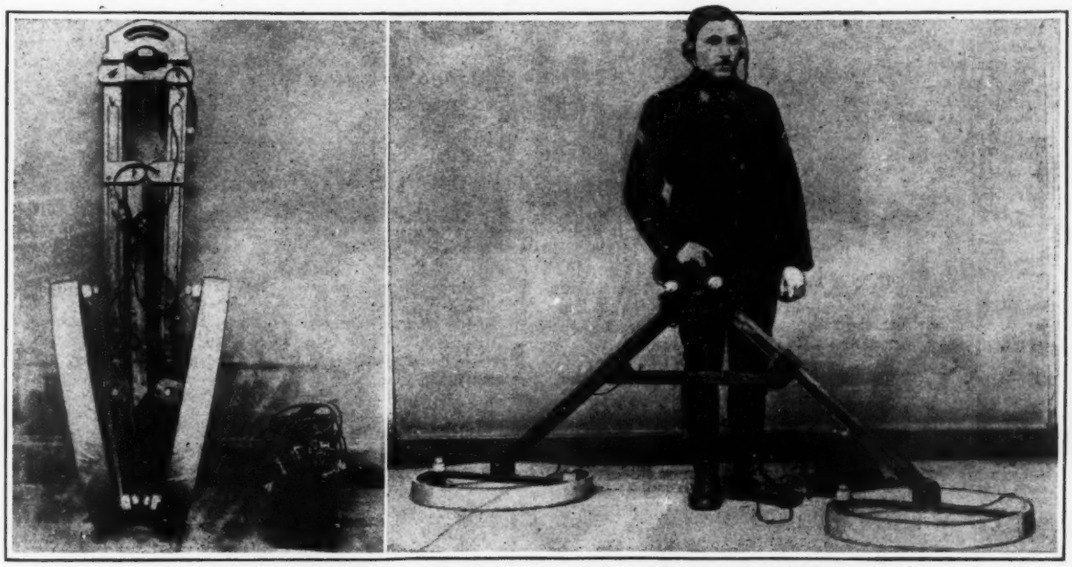
Locating Unexploded Shells on the Battlefields of France

By F. Honoré,
Paris Correspondent of the "Scientific American"

THE location, in ground that has been fought over and subject to bombardment, of projectiles that have failed to explode, constitutes a very delicate problem, and one which must be disposed of before post-bellum agriculture can resume business at the old stand. Shells, to be sure, are relatively of little danger. Their failure to go off in the first instance is, in general, due to broken fuse or an inert charge; and elementary precautions are sufficient for their removal without fear of explosion. Moreover, most "dud" shells penetrate to a depth that can hardly be reached by a plowshare. Grenades, on the other hand, are always active; they are never far from the surface; and the least shock detonates them.



Instrument for locating unexploded shells on battlefields, shown in folded and operative positions

Impelled by the numerous accidents that have befallen cultivators entrusted with the work of agricultural restoration in the devastated regions, M. Guitton, Professor of Physics at Nancy, has got up an ingenious apparatus to determine the position of hidden projectiles. It is based upon the principle of the Hughes induction balance, invented to study the molecular structure of metals and alloys, and also used by the surgeons in

(Continued on page 416)

Sir William Crookes

An Appreciation of a Great Physicist and Chemist

By John W. N. Sullivan

WITH the death of Sir William Crookes, which took place on April 4th, the world of science mourns the loss of an investigator who belonged to a type which is very seldom met with in modern times. Nowadays specialization is so intense that it is hard to find a physicist who has done work in more than one or two branches of physics, or a chemist who has done work in more than one or two branches of chemistry; but in Sir William Crookes we had a man who was a direct descendant from the giants of old; men who could turn their attention with equal ease to several of the great divisions of science, and achieve work of lasting importance in each. Sir William was born in 1832 and his life is one long record of scientific research. In 1861 he achieved his first great scientific discovery, the discovery of the new metal, thallium. He was led to this discovery in a course of analysis of 10 pounds of the seleniferous deposit from the sulphuric acid manufactory at Tilkerode, in the Hartz Mountains, the substance being placed at his disposal by Prof. Hofmann in the year 1850. Spectroscopic examination revealed a bright green line which he had never met with before, and which he found to be characteristic of a new metal. During the next 12 years researches on the many properties of the new element were carried out, culminating in his determination of the atomic weight. The amount of labor involved was immense and the care with which the investigation was carried out was such that even now Crookes' value for the atomic weight of thallium is regarded as the best. With the now accepted values for the atomic weights of oxygen and nitrogen the atomic weight of thallium, as determined by Crookes, is 204.04.

In making this determination Crookes was troubled by irregularities in the weighings and, as so often happens in scientific work, was led to a new discovery, by investigating these apparent errors. The weighings were made in a partial vacuum, but the action of the balance in these conditions appeared most capricious. The weight of the substance appeared to vary with the temperature, but not always in the same direction. As a result of his persistent efforts to trace the cause of these disconcerting phenomena he was led to invent the well-known instrument, the radiometer. The dynamical theory of gases at once furnished an explanation of the curious effects observed, in terms of the action of the residual gas left over in the vacuum; and in spite of the immense amount of work on the stresses in rarefied gases resulting from inequalities in temperature, to which Crookes' discovery gave birth, the subject is not yet exhausted.

Crookes was thus led to consider the phenomena which take place in high vacua, and in his subsequent researches we have the very flower of his work. It is well known that if we pass an electric discharge through a high vacuum, rays are shot out from the negative electrode, the kathode, called kathode rays. They had been investigated before Sir William published his experiments in 1879, by Glucker in 1859, by Hittorf in 1869, and by Goldstein in 1876, but Crookes, in a series of brilliant experiments, greatly extended our knowledge of their properties and propounded the theory as to their constitution which, in a refined form, is the one that is accepted at the present day.

He showed that the kathode rays proceed in a straight line from the negative electrode wherever the positive electrode may be: that they cast a shadow when intercepted by solid matter and that they exert a strong mechanical action where they strike. He showed that they are influenced by a magnetic field, the direction of motion being changed; and that heat is produced when their motion is arrested. He also conducted some beautiful experiments on the power of the kathode rays to excite phosphorescence in preparations of calcium sulfide shining with blue-violet, yellow, orange or green light, in diamonds shining with nearly all the colors of the rainbow, and in rubies glowing with a rich full red.

Crookes considered the kathode rays to be matter in a fourth state, neither solid, liquid, nor gaseous. He regarded them as constituted of particles negatively charged and projected with great velocity from the negative electrode.

In essentials this is the modern view of the rays except that while Sir William regarded the negatively charged particles to have molecular dimensions, they are now known to be very much smaller than the smallest known atom. With real prophetic insight Crookes saw the part that these high vacua phenomena would play in the advance of science, and in view of the fact that these phenomena underlie the whole of modern physics and have entirely changed our conceptions of the material universe, it is of the greatest interest to read the following words of Crookes when he alone among his contemporaries foresaw the present development in physics:

"In studying this fourth state of matter, we seem at length to have within our grasp and obedient to our control the little indivisible particles which, with good warrant, are supposed to constitute the physical basis of the universe. We have seen that in some of its properties radiant matter is as material as this table, while in other properties it almost assumes the character of radiant energy. We have actually touched the border land where matter and force seem to merge into one another, the shadowy realm between known and unknown, which for me has always had peculiar temptations. I venture to think that the greatest scientific problems of the future will find their solution in this border land, and even beyond; here, it seems to me, lie ultimate realities, subtle, far-reaching, wonderful.

'Yet all these were, when no man did them know,
Yet have from wisest ages hidden been;
And later times things more unknowne shall show,
Why then should witlesse man so much misweene
That nothing is but that which he hath seen?'"

It is pleasant to think that Sir William lived long enough to see his predictions verified and to get a fuller view of that mysterious and attractive region which lies just over the border.

Crookes next, in 1881, published a research in which he returns to considerations connected with the dynamical theory of gases. Maxwell had made the great theoretical discovery that the viscosity of a gas is independent of the density, and it had already been the starting point for experimental observations by Maxwell himself, Kundt and Warburg, using the method of rotating disks. Crookes took up the subject and devised a very simple yet efficient orm of apparatus. He merely suspended a lamina within a bulb containing the gas and noticed the subsidence of its oscillations when it was set vibrating. He found, what Maxwell had himself foreseen, that Maxwell's law completely breaks down for very high exhaustions.

In the same year Crookes published a paper on an entirely new method of spectrum analysis, based on the fact that under the influence of kathode rays a large number of substances emit phosphorescent light. The phosphorescent light from most bodies has a continuous spectrum, but in some cases the spectrum is discontinuous, and Crookes made a special study of such bodies. These experiments comprise his well known researches on the rare earths, especially yttria in some of its compounds, and in this connection he obtained very valuable results, to which he made intermittent additions as time went on, including the discovery a few years ago, of a new earth, characterized by an isolated strong group of lines high up in the ultra-violet, ascribed by Sir William to a new element named by him victorium.

In more recent times he did some valuable experimental work on radium. The substance known as uranium X was first separated from uranium by Crookes in 1900, by two distinct chemical methods. His well known and popular instrument, the spinthariscope, was the outcome of his discovery in 1903 that the alpha rays from radium produce, by their bombardment, phosphorescence on a target of crystalline zinc sulphide.

He married in 1856, when only 24 years of age. He was a member of numerous scientific societies both in England and abroad, and among numerous other honors received the Copley Medal in 1904. He was knighted by Queen Victoria in 1897 and achieved the greatest honor open to an English man of science by being elected president of the Royal Society in 1913.

His striking combination of diverse gifts, keen observation, patient and inexhaustible experimental skill, together with the glowing mind and imagination of a poet, have assured him for all time a settled place in the great list of English men of science.

Sir William Crookes

Italian Lavas as a Source of Potash

DR. Henry S. Washington, of the Carnegie Geophysical Laboratory, has published a computation of the total amount of potash present in the lavas of the six chief volcanoes along the west coast of Italy that have erupted leucitic lavas. A conservative estimate is 10,000,000,000 tons of potash (K_2O). Dr. Washington believes that in these volcanoes Italy possesses one of the largest visible supplies of potash known to exist, if not the largest. Important silicate-rock sources of potash are also available in the United States, including the Leucite Hills in Wyoming and the belt of glauconite that extends from New Jersey into Virginia. The latter is estimated by Dr. Washington to contain 2,034,000,000 metric tons of potash.

The French Problem of Reconstruction—I

In the Path of the Shell

By C. H. Claudy, Special Correspondent of the SCIENTIFIC AMERICAN in Paris

IT is not possible to visualize the English reconstruction problems from a platform constructed solely of American ideas. It is less possible to see all of the French problem from any viewpoint 3,000 miles away, no matter how aided with photographs, with descriptions, with talks, lectures, exhibits.

It is an impossibility for the human mind to grasp the extent of the physical destruction in France, even with the direct aid of the senses; and if the traveler in and around the devastated regions finds it impossible to realize the extent of what he sees and hears, how much more difficult must it be for him who must depend upon the written word, the printed picture, to grasp the amount of damage done?

So one starts the statement of the problem with the full knowledge that, after all, figures are only insensate things, and phrases like "the town is totally destroyed" come to lack power to convey idea merely from their constant repetition and their utter inadequacy to represent the matter of the destruction or the desolation which hangs a pall of absolute lifelessness over the areas where the Hun, the shell, the wanton destruction and that not wanton but inevitable in war, have laid their searing touch.

In England the reconstruction problem is entirely economic, political, social. The physical aspects of her post-war puzzle are merely the mechanical ones of conversion of war plant to peace basis, of construction of delayed buildings, of putting in condition run down railroads, of rebuilding shattered industries, of resettling altered labor conditions.

In the United States where we talk much and do little (governmentally) about reconstruction, the problem is big only because we have no true perspective upon it; to English eyes it would appear small, and to French eyes it does not exist! For the French problem of reconstruction is first and foremost a physical one—a matter of building homes again where are now piles of ruins—a matter of getting under cultivation, land which is now a mass of shell holes—a matter of making fields of grass and grain out of fields of barb wire and poles—a matter of making roads, mending bridges, getting machinery, erecting buildings in which to put the machinery, persuading absent and scattered population to come back to the new town and into the new building to run the new machinery. Before France is ready to think much about economic reconstruction she wants homes for her homeless, and tools for the toolless. She wants smiling towns where now gape raw wounds in the landscape—she wants fields which are of use to man where are now charnel houses, bone yards, pitted areas of clay and mold, useless alike for farm, for home, for pasture or even for weeds.

So it seems reasonable to attempt to give some idea, be it never so feeble, of the extent of the physical problem, before trying to show what France is doing to remedy the results of war on her soil. One knows well that neither words nor pictures are adequate, but they are the only means by which those not able to come and see for themselves can get even a hint of what has here been done.

Figures are not impressive in themselves. To say, for instance, that the total area of destruction in France is about two per cent of the total area of France is apt to make a reader exclaim mentally, "Oh, well, that's not so bad, after all—I thought about half of France was damaged!" The total area in the devastated region is about 6,000 square miles of territory, supporting about two million people. Do not confuse this with the total invaded area of France; at the time the Hun was farthest in he had control of over five per cent of France. At one time the invader occupied 15,000 miles, including 3,500 communes, containing over four million people. But even the Hun cannot destroy when he retreats in a hurry, and much of what he might have destroyed he postponed because he wanted it for himself. Where armies swing back and forth quickly, in advance and retreat, the destruction is superficial—grain trampled, cattle stolen, fences razed, wooden buildings (of which France has very few) burned. But where armies face each other, locked in position, for some time, destruction is absolute, and often it is as much the work of the shells of the defender as of the wantonness of the invader.

The destruction of war is of several varieties. That resulting from shell fire is probably the hardest to remedy, since it includes not only the razing of buildings and the annihilation of forests, but also the churning up of land so that it may be years before a top soil again forms upon it, capable of raising any sort of a crop. The intentional destruction, where towns are burned, bridges mined and fruit trees girdled, is bad enough, but all the intentional destruction in France put together would probably not total a half of the inevitable result of the landing of millions and millions of pounds of high explosive in field and street, in garden, orchard and wood.

Yankee infantry streaming through the captured town of Varennes in the Argonne

France is facing half a dozen different problems at once, and has courage enough for a few more if the world wants her to face more! The Peace Conference is one of them, her army is another, her army of occupation in Germany is another, feeding herself yet another; and still she finds time to investigate the amount of her wounds and plan for their healing.

France estimates (and no very accurate census of buildings is possible in so short a time) since the armistice, that the total physical damage to buildings will reach the round figure of half a million structures; and that of these, at least half (250,000) have been completely destroyed.

One wishes it were possible to make the words carry the meaning. One rides for mile after mile through the devastated region and sees these things—these sites where once were towns—these rubbish heaps of stones which once were buildings—these little mounds of stone and dust and mortar with here and there a gateway, half a wall, a solitary pillar or the fragment of an arch stretching mournfully upwards—and never a sign of life. No man, woman nor child, nor cow, horse nor goat, no bird, no insect, no rat nor cat, nothing but blasted stone, often so churned into the landscape that the streets of a once prosperous town are completely obliterated, and if it were not for map and guide one would not know that here stood a prosperous village.

How can figures, or words, or pictures, make that evident to him who has not seen it? They cannot, and one can but feel regret at the inability of the only means at hand to paint the picture, and the impossibility of every reader's making a magic-carpet journey through the devastated regions, to see for himself what France is facing, and learn at first hand what she has suffered—if only that our own little reconstruction problems took their proper place in our minds and our own woes dwarfed themselves to their proper proportions!

However, since figures are all that one has with which to paint, let us write figures! A quarter of a million buildings destroyed and another quarter million damaged can make rather large figures possible. French government engineers say the average cost of the destroyed buildings prior to the war was $5,000—that their present cost of replacement is two and a half times that much and that the total cost of rebuilding the houses, damaged and destroyed, will be in excess of $6,000,000,000—a regular Liberty Loan figure! Architects and contractors' associations are a little more moderate in their estimate—perhaps the government had an eye to possible scaling down of damages if Germany is compelled to divide up her income pro rata among all the allies, in indemnity payments for years to come—and such associations call the total damage $4,000,000,000 to buildings alone.

France is a country of stone, tile, mortar, brick; the wooden house is almost unknown. Arguing from this, many who have not seen a ruined town have said "but the material is there, it is merely displaced. It won't cost so much to rebuild when the stone is right at hand!"

But the shell does not merely displace stone; it splinters it. There are towns which are not ruins, but rubble piles; where not only is there not one stone on another, but literally not one stone left whole; where rebuilding must start with hauling away all the rubbish of what was once a town, or the selection of a new town sight.

This latter, indeed, seems so simple a procedure to an American as to make it appear a necessity. There would be no question in American minds that, given a totally ruined town now but a mass of rubble and stone, it would be infinitely better to build a new town alongside the old site, hauling what material was available from ruin to building operation, and making the new town with better streets, straighter avenues, better parks, etc., than to clear away and rebuild on the old location.

But "town" to us means municipality. "Town" in the war zone is largely a little collection of houses—mere farmers' residences huddled together for companionship and gregariousness. A wine shop, a bakery, a small store, 10 houses—*voila* a town! The owners of the destroyed buildings do not *want* better streets, straighter avenues, parks—they think of the little town as a collection of homes, not an entity in itself. And the question of land makes the rebuilding of any other site one of tremendous difficulty.

A father wills his land to his sons, his sons to their sons and so on forever. Little farming land is bought and sold in rural France. Land is all but worshipped there. It is *France* they own and till, these peasants. Would you have them sell their country? A man marries a girl

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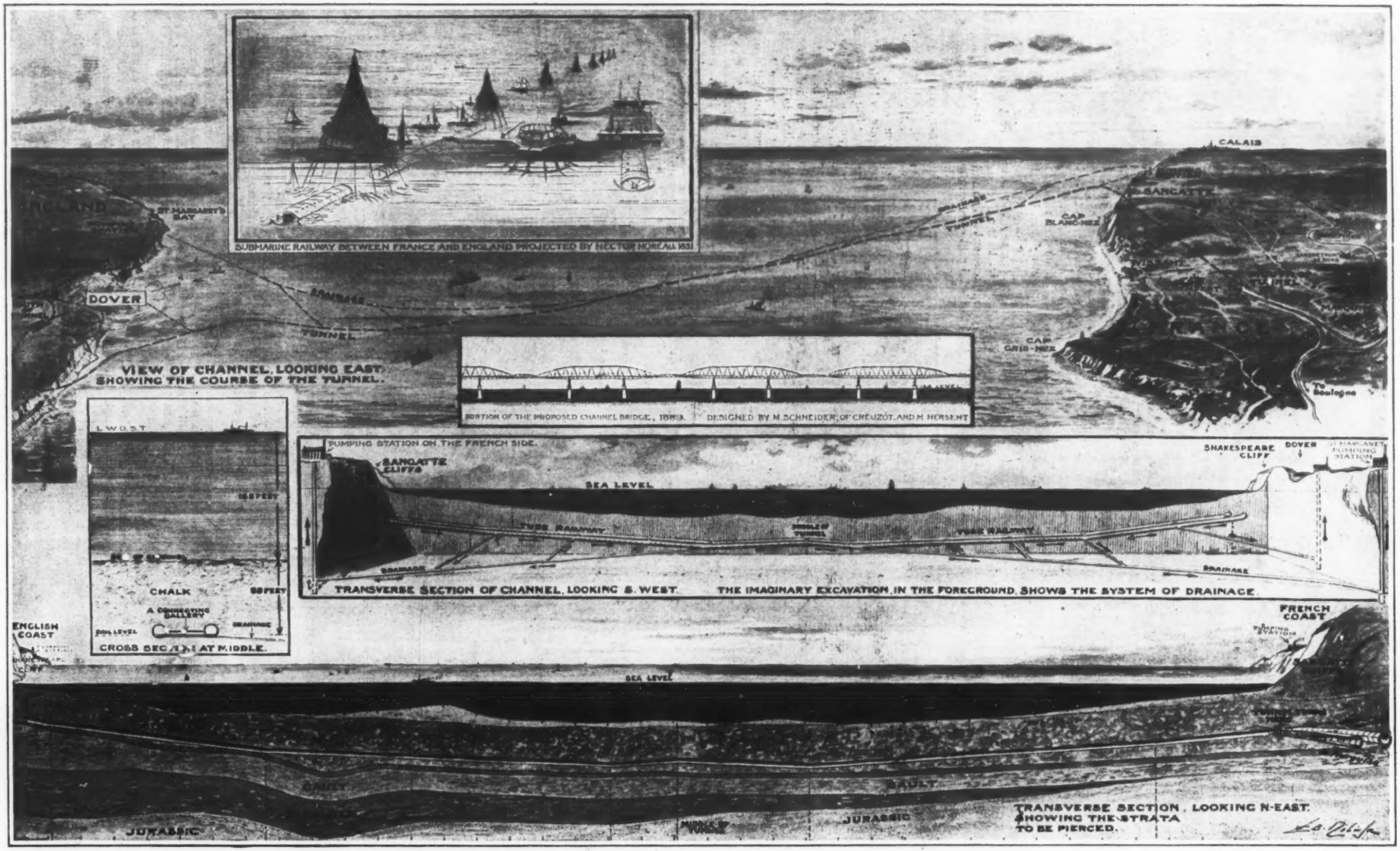


Courtesy of Illustrated London News

GREAT BRITAIN AND FRANCE DECIDE TO BUILD THE CHANNEL TUNNEL

Latest Plans for the Channel Tunnel, Showing Its Course, the Geological Strata, and the System of Drainage; also Earlier Plans for Tubes and a Bridge

FOR over a century the problem of connecting Great Britain and France by some more convenient method of transit than by sailing ship and steamer, has been a favorite subject of investigation by engineers, capitalists, and politicians. Over half a century ago, in its issue of November 22d, 1851, the *Illustrated London News* published an illustrated description of a plan proposed by Hector Horeau, for connecting the opposite shores by an elliptical tube formed of either plate or cast-iron. Apparently the tube was to be built upon shore in sections, which were to be floated out into position by means of caissons and lowered in place. Monsieur Horeau stated that the slope given to the submarine railway "would admit of a motion sufficiently powerful to enable the carriages to cross the Channel without a steam engine." Trains were to run down to the lowest point by gravity and then they were to be moved up the opposing slope either by a stationary engine or by atmospheric pressure. The curious conical structures shown in the engravings are huge lighthouses, which were to be anchored at intervals above the tunnel so as to indicate its location and prevent ships from injuring the tubes by casting anchor. Monsieur Horeau was not wanting in a sense of the pictorial nor in the imaginative faculty. The towers were to bear the names of different nations of the earth. The tube was to be provided with glass windows on its upper face, and "large reflecting plates" were to throw the light from the lanterns down into the tube. In the spaces between lanterns the tube was to be lighted by gas. The estimated cost was $87,400,000. In the hundred years of discussion, the plans have included roadways carried above the channel on bridges; roadways suspended midway between the surface of the water and its bottom, running in a tubular bridge mounted on piers, the whole thing being sub-aqueous; and finally tunnels cut through the strata lying far below the bed of the Channel. Among the proposed bridges, the most notable was that designed by M. Schneider of Creuzot and M. Hersent, with whom was associated Sir Benjamin Baker, designer of the Forth bridge. This gigantic structure, of which we show an illustration, was to consist of 59 separate spans alternately 900 and 1,500 feet in length. The average weight of the bridge would have been 6.2 tons per lineal foot, and the total weight of steel in the whole structure would have been 771,365 tons. The piers were to consist of steel caissons lined with brick work, which were to be floated into position, sunk to the bottom, and carried through to firm, underlying chalk by the well-known compressed-air method.

The English Channel Tunnel

Story of the Agitation for a Channel Tunnel from 1802 to 1919

WITH the exception of the Suez and Panama Canals, there is no constructive work in the field of civil engineering which has had so worldwide an interest as the proposal to link the British Isles with the Continent by some form of roadway. Although in later years the proposal has always contemplated the construction of a tunnel, the student of the history of this project finds that other methods, such as the building of long, low-level jetties; of high-level bridges; and of tubes laid on the bottom, were suggested and were made the subject of more or less serious investigation.

Early French Proposals

The first definite plan was made by a French engineer, M. Mathieu, who proposed to Napoleon I, in 1802, the construction of a tunnel which would afford a post road between the two countries. To Napoleon, himself a great engineer of daring enterprise, the plan must have seemed more feasible than to many of his contemporaries.

In 1833 Thomé de Gamond is said to have made very extensive experimental borings in France and England to determine the character of the geological formation. His labors were indefatigable. Three times he went down in a diving bell to bring up specimens from the bed of the Channel, and altogether, between the years 1833 and 1836, he brought forward no less than six separate proposals. The first of these in 1834 contemplated a tube of iron plate laid on the bed of the Channel from Calais to Dover, the length of which would have been 25½ miles.

Then, in 1836 he proposed the construction of a bridge 22¼ miles in length, which he estimated could be built for $160,000,000.

His third proposal was to build two jetties, each extending five miles out from the shore, with their outer ends connected by a pontoon bridge. This construction would have been 21 miles in length.

His fourth proposal contemplated a jetty reaching from shore to shore, with three navigable channels spanned by swing bridges.

In 1856 he abandoned his previous plans in favor of the more practicable scheme of driving a tunnel from Cape Gris-Nez to a point halfway between Dover and Folkestone. The tunnel was to be so located that it would pass under the east end of what is known as the Varne Shoal, where he proposed to sink a construction shaft.

Ten years later he modified his location so as to make a landing at Folkestone; and he proposed to use the shaft on Varne Shoal to bring up the excavated material and empty the spoil at the shaft, thereby forming an island of considerable extent. In 1869 this plan was so well thought of that a French-British Committee was formed to look into it. The tunnel was to be cut by means of a Rotary Brunton Boring Machine, the estimated time was four to five years, and the cost $40,000,000. De Gamond died in 1875.

In 1851 Hector Horeau drew up the plans for an elliptical iron tube which is illustrated on the preceding page.

British Activities

Meanwhile, the British had been investigating the problem on their own side of the Channel, and in 1866 Chalmers proposed the construction of two circular iron tubes, which were to be laid on the bed of the Channel. These were to be lined with brick and cased externally with timber. Chalmers claimed that the tides would silt up the tubes and thereby ultimately form an embankment 40 feet high by 150 feet wide. The estimated cost of this scheme was $60,000,000.

We should state, just here, that for the above data on the French investiagtions and for the following account of the British end of the enterprise, we are indebted to a series of chapters which ran in *The Engineer* of London, of November and December, 1916, to which the reader is referred for fuller particulars.

Chalmers was followed by Charles Marden, who designed a tube with a double skin, the annular space between the skins to be filled in with concrete. The estimated cost of this tube was about $62,000,000.

In the early part of the latter half of the 19th century, considerable attention was given by engineers to the possibility of pneumatic operation of trains, and we find that subsequently to Marden's proposal, Bateman and Révy got out a design for a cast-iron tube which was to be carefully machined on its interior face, and closely fitting cars were to be propelled through it by pneumatic power.

Zerah Colburn, that prolific and original engineer, proposed the construction of the tube in sections in a long drydock. When a section had been completed, it was to be forced out through the dock gates, some form of stuffing-box being contemplated which would allow this to be done.

Then came Page, who in 1870 proposed to moor at intervals across the Channel eight iron shafts and to lay the tubes between them on the bed of the Channel. They were to be covered with concrete.

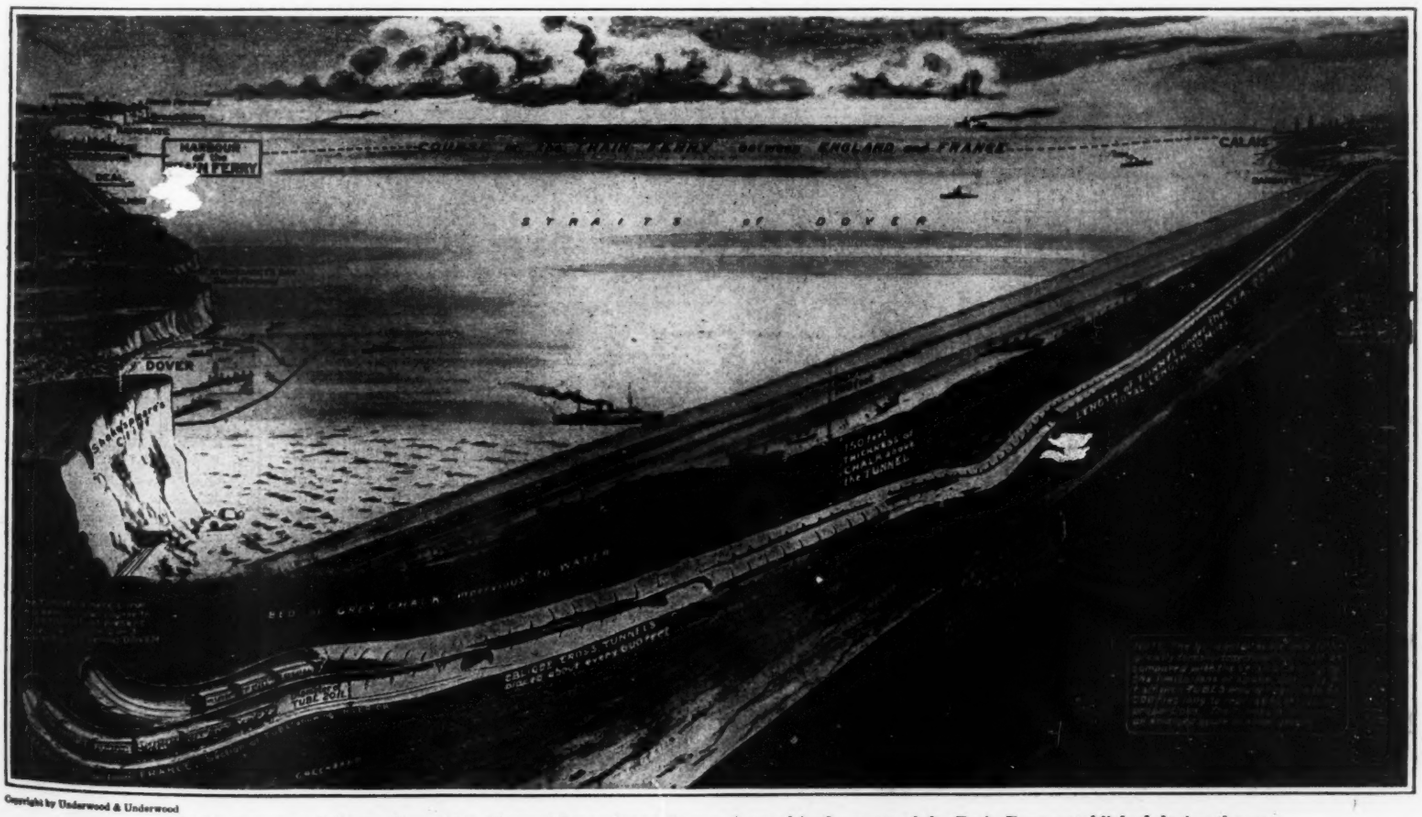
Next came Peter W. Barlow, who proposed an iron tube, which was to be surrounded with 2 feet 3 inches of brick laid in asphalt. Outside of the brickwork was to be a covering of six inches of timber. Barlow was optimistic as to cost, believing that the thing could be done for $25,000,000.

Then came Paul J. Bishop, with two elliptical cast-iron tubes, which he believed that he could put across for $110,000,000. The tubes were to be lined with 12 inches of brick laid in cement, with a facing of ½-inch plate. Traction was to be either by steam locomotives or pneumatic.

An Exhaustive Investigation

This brings us to the great Sir John Hawkshaw, who, in company with Sir James Brunlees and Mr. William Low, began to study the problem in 1864 and devoted an immense amount of time and energy to the work. Extensive borings were made on either shore, and a thorough geological examination was made of the bottom to determine the lay of the strata. As the outcome, a complete Channel tunnel scheme was developed by Sir John Hawkshaw as engineer of a company formed in 1872. Sir John realized that the project was first and last a geological one. Special apparatus was designed for sounding and securing specimens of the bottom. The question was to determine whether the thickness of the lower beds of chalk as measured on the white cliffs on the British and French sides, where all the beds are exposed, was maintained after the lower beds dip beneath the sea. The borings showed no great diminishing of thickness as the beds were followed seaward from the outcrop. A concession was attained in 1875 from the French, and an English bill was presented in 1875. It should be mentioned that though the attitude of the British government was always conservative, the French

(*Continued on page 416*)



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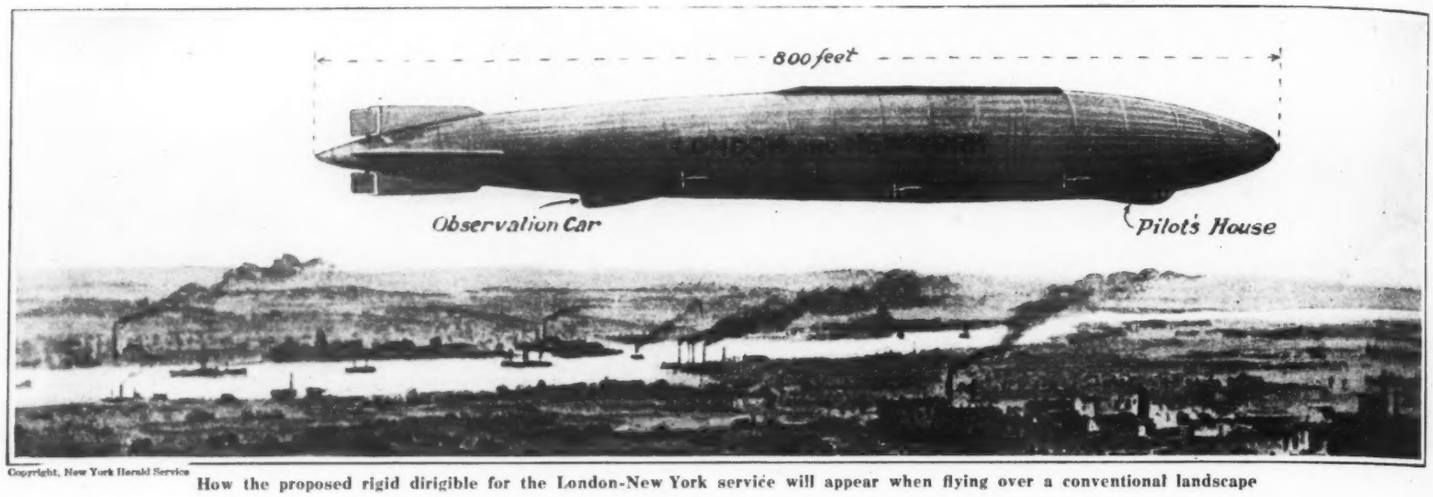
In the foreground the landing of the Channel Tunnel near Dover; beyond is the route of the Train Ferry established during the war



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How the proposed rigid dirigible for the London-New York service will appear when flying over a conventional landscape

Aerial Greyhounds of To-Morrow

Some Possibilities of Airship Transport Service in the Immediate Future

NEW YORK to London in two days! Traveling via the air with the smoothness and speed of an express train while enjoying the spaciousness and accommodations of an ocean liner! Making the trans-Atlantic crossing with a feeling of security which has never before been equalled!

These are not excerpts from the prophetic writings of Jules Verne or the imaginary essays of H. G. Wells. Far from being the products of a vivid imagination, they are the cold conclusions of a leading British organization which has set to work on the problem of commercial aviation. And this organization, by the way, is a vast and influential one; indeed, during the war and for many years before, its name has been synonymous for battleships and hand grenades, airplanes and dirigibles, machine guns and huge mortars. Basing their calculations on well-known performances and accepted practices, the engineers of the organization in question have worked out an impassionate report and comprehensive plans and drawings on what may be done with huge passenger-carrying dirigibles in the immediate future. All of which proves interesting and informative reading, not only to the many thousands of men who have become identified with aviation as a consequence of the war but to the masses as well.

Wherein the Dirigible is Better than the Airplane

The outstanding and peculiar advantage of the airship for air transport is its capacity for making non-stop voyages of long duration; whereas, from inherent limitations, the airplane will probably never—unless some radically new principle of design is discovered—be capable of carrying a passenger load for greater non-stop distances than 2,000 miles, and for economic operation will probably never be used for non-stop flights of more than 1,000 miles; whereas, on the other hand, the only limit to the non-stop length of flight that can be made by an airship is determined by the size of ship—and 10,000 miles is quite practicable.

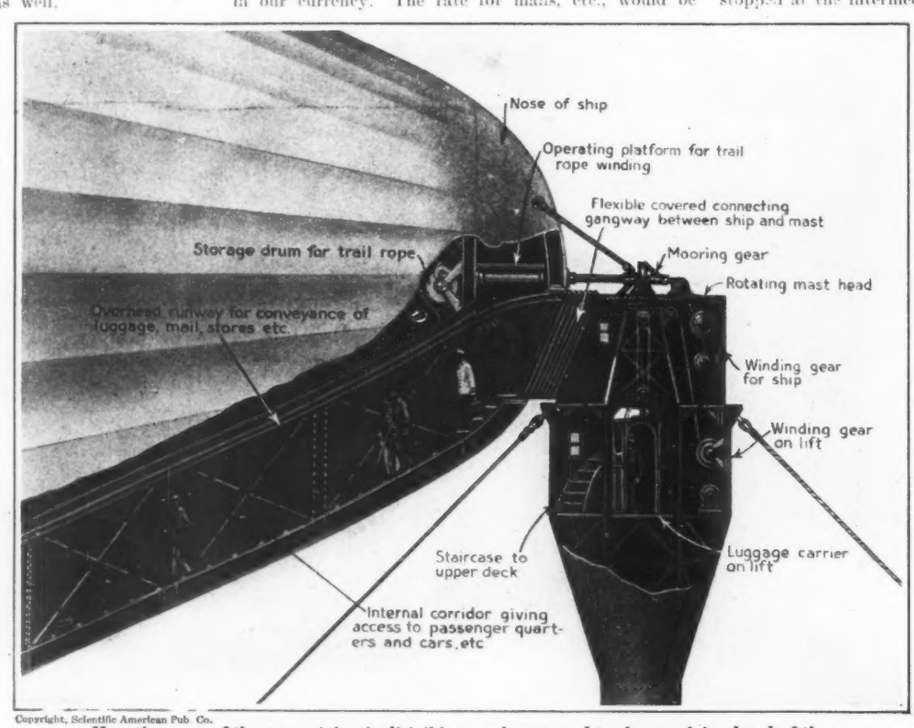
An airship of the size proposed by the engineers of the British organization, namely, of a capacity of 3,500,000 cubic feet, which could be built immediately and be housed in existing sheds, can carry 15 tons of passengers, mails, and so on for an air distance of 4,800 miles, at a speed of 60 miles per hour. And it would be quite a practicable proposition to build a rigid airship to carry 50 tons of passengers and freight for a non-stop voyage of 10,000 miles, at a speed of 80 miles per hour. It therefore may be definitely accepted that for voyages on which it is necessary to make a non-stop flight between points more than 2,000 miles apart, the dirigible is the only means of aerial transport possible, and it may also be safely stated that the airship will always be the most economical means of transport for non-stop voyages of more than 1,500 miles. So it follows that the dirigible must hold the field for long-distance voyages, such as the trans-oceanic routes.

Consider, however, a concrete case. The engineers have chosen the direct non-stop passenger voyage from London to New York—a minimum distance of 3,000 miles—for their comparison between dirigible and airplane services. The analysis is made of the cost of operating a service of two crossings in each direction per week, giving a carrying capacity of 30 tons of passengers, mails, etc., in each direction. Now then, with a capitalization of £2,500,000 (£=$4.85), and allowing 10 per cent on capital and a high rate of depreciation and insurance, the cost of operation would be as follows: Carrying passengers from London to New York, £45 per head, which figures out to about eight cents per mile in our currency. The rate for mails, etc., would be established in all likelihood at about six cents per ounce.

The time taken for the journey would be two and a half days from London to New York by the southern route, and two days from New York to London by the direct route, all these facts, of course, being based on rigid dirigibles such as have been proposed.

Turning to the airplane, we learn that it is impossible to run an airplane service direct from London to New York; but with the largest and most efficient machines at present considered practicable, it would be possible to run a London to New York service with intermediate stops in Ireland and Newfoundland for replenishment of fuel, etc. The capital required in this case would be £3,850,000, and the cost of operation would be: Passenger rate from London to New York, £115, which figures out at the rate of some 16 cents per passenger mile, while mail and other light merchandise would be charged for at the rate of 15 cents per ounce.

The time taken, allowing for stops in Ireland and Newfoundland, would be two days. It seems obvious that for a regular and established service, the cost of trans-Atlantic dirigible service is less than half that of the airplane, and the time taken is practically the same. It must, however, be pointed out that if the airship stopped at the intermediate points as necessary for the airplane, a considerably greater amount of passenger load could be carried, and the relative cost of airship operation would be considerably further decreased.


Nose of ship
Operating platform for trail rope winding
Flexible covered connecting gangway between ship and mast
Storage drum for trail rope
Mooring gear
Rotating mast head
Overhead runway for conveyance of luggage, mail, stores etc.
Winding gear for ship
Winding gear on lift
Staircase to upper deck
Luggage carrier on lift
Internal corridor giving access to passenger quarters and cars, etc

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How the nose of the trans-Atlantic dirigible may be moored to the revolving head of the mooring tower, serving as an anchorage and gangway combined

Annihilators of Distances

With the development of airship transport to the most distant centers of the world, it is conceivable that no important city will be farther from London than 10 days' journey; and the engineers have given some representative aerial routes from London as follows: To New York, 2-2½ days; San Francisco, 4½ days; Cairo, 1½; Colombo, 4½; Perth, 7; Nairobi, 3½; Capetown, 5½; Rio Janerio, 4 days.

The advantages of airship transport will be most apparent for long ocean journeys, and it is proposed that the best route for the first service would be between London and New York, as this is the route on which there is the greatest demand for a saving in the duration of voyage, and a large amount of passenger traffic would be immediately available once the advantages of the service were demonstrated. After the establishment of the

trans-Atlantic service, other services on which airship transport would effect great economies in time would be: London to Cairo (Egypt), 2,050 miles; Cairo to Colombo (Ceylon), 3,400; Colombo to Perth (Australia), 3,150 miles. By train and mail steamer, the journey to Colombo at present takes 15 days, and to Australia over 30 days, as compared with the figures already given for the dirigible service.

Further than the saving in time in the actual journey, there is the saving by using an airship service in the elimination of the time taken for trans-shipping and waiting at the various ports and so on, where the airdromes could be situated quite close to the terminal stations. Owing to the variation in weather conditions, there would be of course some latitude in the time of arrival at the destination; but in those cases where there is a saving of several days in the total journey, the variation of a few hours in the time of arrival would not be of much account.

Much more could be written on the time-saving and other features of the aerial transport service proposed, for the engineers have gone down to the very bed rock of all the factors entering into the operation of the dirigibles. They have figured out the costs to a nicety, even including the costs of overhauling andrepairing, insurance premiums, depreciation, interests on capital invested, fuel, crew, and so on.

But from the viewpoint of the layman the interest now shifts to the craft to be employed. After all, it is the dirigible covering the route which deserves particular attention, since all plans stand or fall by the practicability of the carrier.

A Greyhound of the Skies

In brief, the proposed rigid dirigible, which is herewith illustrated as well as in the cover illustration of this number, has the following characteristics:

Gross gas capacity, 3,500,000 cubic feet; overall length, 800 feet; maximum diameter and overall width, 100 feet; overall height, 105 feet; total lift (at 68 pounds per 1,000 cubic feet), 105 tons; disposal lift, 68 tons; total maximum power of engines, 3,500 horse-power; cruising horsepower, 2,000; speed at full power, 75 miles per hour; speed at cruising power, 60 miles per hour; endurance at cruising power, when carrying 15 tons of passengers and freight, 80 hours for 4,800 miles, and when carrying 10 tons of passengers and freight, 90 hours for 5,400 miles.

It should be noted that the "disposal lift" is the lift available for fuel and oil, stores, crew and passengers, mails, and freight. The particulars and performance stated are based on present design, and the actual performance of ships of 2,000,000 cubic feet capacity now in service. It is believed that the figures given are conservative, and that actually the increased size of ship would enable greater structural efficiency and consequently greater disposable lift available than that specified.

The shape of the trans-Atlantic dirigible is to be of the most perfect streamline form within the limitations of constructional requirements. An internal keel corridor, running along the bottom of the hull, will afford access to every part of the dirigible. Petrol and oil tanks and water ballast will be contained in the hull structure. The outer covering would be made of special weather-proof fabric to give the longest possible life when subjected to the weather effects on continuous voyages; also, to be as efficient as possible in insulating the gas from change of temperature, and so avoid great variations.

The gas capacity of the dirigible would be divided into gasbags made of suitable rubber-proofed cotton fabric lined with goldbeater's skins. The gas-bags would be fitted with automatic relief valves and hand-controlled maneuvering valves, operated by the pilot from the navigating quarters located well up forward.

The engineers have planned on six machinery cars or "power eggs," each containing a 600-horse-power engine, directly connected with a propeller fitted at the aft end. Thus the dirigible would have a maximum power of over 3,500 horse-power, the engines being designed to develop their maximum full power when flying at a height of 5,000 feet. The engines would be fitted with special exhaust silencers in order to reduce the exhaust noises to a minimum, and special consideration would be given to the transmission gear, cooling system, self-starting features, and so on.

Promenade Decks and Salons Among the Clouds

But how about the living quarters, now that the mechanical details have been glanced over?

Well, the main living accommodations would be in a salon fitted along the top of the airship, provided with tables and chairs in the style of a Pullman car, which would enable the passengers to be comfortably accommodated during the daytime. Part of this salon would be fire-proofed to allow of being used as a smoke room. An open shelter deck would also be provided at the aft end to enable the passengers to take the air. The salons would be provided with windows, giving the passengers an all-round outlook.

A passenger elevator would be provided for communication between the passengers' quarters and the lower part of the ship. An observation car, fitted below the hull towards the aft end of the airship, would also enable passengers to observe the land and sea immediately below the ship. As for sleeping quarters, these would be in the form of berths provided in small cabins fitted on top of the huge hull, forward of the living salons. Cooking would be done in a mess kitchen, thoroughly equipped with electrical cooking apparatus. Meals would be served in the salon. Heat for salons and sleeping quarters would be radiated by electric heaters.

It is interesting to note that such a dirigible would be equipped with the last word in wireless apparatus, enabling it to keep in touch with land stations and ships, and also permitting of the reception of directional signals at all times. In fact, directional wireless signals today make it possible for an airship to be piloted with considerable accuracy, even if it is enshrouded in thick fog or is operating at night.

So much for the airship. But how about the landing facilities? It has often been said of the dirigible that it is far better in the air than on the ground, and that the problem of getting it up is nothing compared to that of bringing it down—safely. Again we find that the British engineers have done their work well and thoroughly; truly, they have taken up this matter of air transportation in all seriousness.

At the terminal point of each airship route, it would be necessary to make provision for the following: 1st. An airdrome of about one mile square. 2d. A double airship shed capable of housing two of the airships. 3d. a mooring-out tower, with bow mooring gear. 4th. Mechanical handling gear for transferring the airship from the mooring tower to the shed. 5th. Hydrogen generating plant and storage. 6th. Repair workshops and stores. 7th. Meteorological office and wireless telegraph installation. 8th. Electrical night signaling and lighting arrangements for the airdrome. 9th. Offices, etc.

The airdrome should be within direct communication and a short distance from the city served by the airship service, and, if possible, would be advantageously situated near to a chemical works where hydrogen would be obtained as a by-product. In this connection it is interesting to note that the British engineers have figured on hydrogen instead of non-inflammable helium, although it is practically certain that the latter would sooner or later take the place of the former.

The double sheds required to house the size of airships called for would require two berths, each with a minimum size of 850 feet long, 150 feet wide, and 115 feet high, with opening doors. The sheds would be provided with hydrogen filling mains and with gear for slinging the airships from the roof when deflated for overhauling. Special arrangements would be made to enable rapid replenishing of the ships with gas, fuel and water ballast.

A Hitching Post for Dirigibles

Most interesting of all the airdrome arrangements, however, is the proposed mooring-out scheme which has been made the subject of a patent by the British organization. This scheme, which forms the opening page subject of this number, would be introduced at each airdrome, in the shape of a fixed mooring tower about 150 feet in height, with a revolving head to which the airship would be rigidly attached by the nose and be able to turn round in accordance with the direction of the wind. This tower would be provided with a hauling-in winch and rope to haul the ship up to the mooring point. Means would be provided at this mooring tower to enable the airship to be supplied with hydrogen, fuel and water ballast whilst moored out. An elevator from the ground to the top of the tower would enable passengers to embark and disembark whilst the airship was riding at the mooring, and would also serve to convey mails, freight, stores, etc., to the ship. The airship would be moored to this mast and ride out during even the worst weather, and would only require to be taken into the shed when lying up for overhauling and repairs. And this scheme is based on substantial fact: for it is a matter of record that a British dirigible has been anchored

(Continued on page 418)

Courtesy, Illustrated London News

In the no distant future captive balloons, equipped with electric lamps of high power, will mark important airdromes and landmarks for the aerial pilots of commercial and pleasure craft

World Markets for American Manufactures

Edited by LYNN W. MEEKINS

A department devoted to the extension of American trade in foreign lands

Readjusted British Industries

AMERICAN manufacturers whose plants were engaged in war work are following with interest the changes now going on in British factories. It has proved easier in both the United States and Great Britain to return to a peace basis than it was to go upon a war basis. The striking fact in the latter country is the number of firms that have turned to the production of articles that are being imported at present. Before the war a company in Leicester used to handle American typewriters; it will make its own machines henceforth. From the manufacture of vulcanite pressings for magnetos another Leicester firm has changed its line to fountain pens, replacing American makes. British plants that produced airplanes for war use are turning out furniture, iron valves, automobile accessories, capstan lathes and marine motors. Great establishments from which continuous streams of munitions were poured into France have been converted for the manufacture of such articles as electrical fittings, presses for brickmaking, files and springs, cream separators, dairy utensils, shoe machinery and locomotives.

No longer required to make millions of yards of army cloth, the British textile industry has readjusted its looms and undertaken to regain its strong hold upon foreign and colonial markets. There has been a movement in England for the enlargement of the producing units in order to reduce the manufacturing cost of the diversified lines of cotton goods with which the natives of India, China and other vast consuming countries are supplied. Germany used to sell to British mills nearly all the hosiery needles that they employed; these are being made now by several former munition plants in England. In connection with the restoration of French and Belgian textile industries, a great deal of the necessary machinery will be sold by British manufacturers, whose equipment is already familiar to the owners of the looted or devastated factories on the Continent.

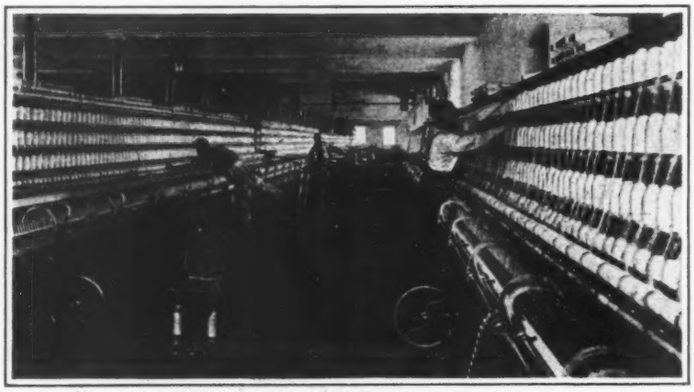
One-third of our six billion dollars' worth of exports in 1918 went to the United Kingdom, which has been a constantly growing market for American goods. In dealing with our transatlantic customers we have the advantage of a common language and the benefit of good transportation. Just now the British Government is regulating the trade in a number of commodities, making it necessary for importers of certain American products to obtain licenses; but this restriction will be relaxed as the exchange situation improves. In the five-year period preceding the war, the United Kingdom bought German goods valued at nearly $1,400,000,000, the total in 1913 being over $100,000,000 in excess of that in 1909. This business has come to the United States and we ought to keep most of it.

Many American manufacturers have obtained a good share of British trade by establishing branch factories across the ocean. One firm that makes paper goods allowed five years for the working out of such an experiment and found it successful within half that time. Owing to the higher wages paid during the war, the standard of living in Great Britain has improved to such an extent that American exporters can sell more of our products there, regardless of the industrial changes that have been mentioned. The demand is for standard lines inclining toward the luxury class.

Exporting the Bolsheviki

"NEVER hunt for trouble; it will always come to you" is an old saying, and even when not sought, but merely expected, that unwelcome visitor is likely to appear. Upon the signing of the armistice it was freely predicted that we should have hard times in this country, the readjustment to a peace basis involving curtailed production and a great deal of unemployment. Fortunately, we were not in the war long enough to make a vast amount of rearrangement necessary. We did, however, tune up our industries to such high speed that the domestic market is no longer capable of absorbing the output, and those manufacturers who haven't gone into foreign fields are the chief sufferers.

American goods are shipped from Atlantic, Pacific and Gulf ports, unless they are sent to Canada or to Mexico by rail; and around these ports is naturally centered most of the interest in our export trade. It is from inland factories, though, that a very large proportion of our export products comes, and the more energy displayed by manufacturers in the Middle West and in other sections the more speedily the United States as a whole will be placed upon a firm world trade basis.



A British spinning mill using American cotton

Keeping Our Workmen Busy

"The first need of the American workingman today is stability of employment—the assurance of steady work," said a noted economist the other day. He proposes the passage of legislation compelling manufacturers to pay an unemployment tax—50 cents a day to each man who is laid off on account of a slack in orders. Whatever the merits of such a measure may be, it is certain that trouble would follow in its wake. The one great unemployment cure is foreign trade, which means a continuous flow of business and a maintained or increased working force. When the domestic market is dull, a harder drive may be made in Latin America or in the Far East. The point is that American products must be shipped abroad steadily and foreign fields must be carefully cultivated all the while. Export trade is not a matter of getting rid of a surplus. Our world customers want American quality goods backed by efficient service.

One of the largest and most up-to-date loom weaving sheds in Lancashire, using American cotton

Sweden used to be the principal source of supply for safety matches. The war handicapped Swedish manufacturers, shutting off their raw materials and taking away much of their shipping space. Along came Japan—and that leads us into a sparsely settled region not far from Lake Michigan. Not long ago a paper mill in that section received a very large order for the particular kinds of paper used in making the little boxes in which safety matches are sold—for the exact kinds, in fact, that Swedish manufacturers employed—and this order was shipped to a large match factory in Japan. Now, at least one company in the United States is producing safety matches, but the quality of American products is so universally recognized that our manufacturers are not compelled to copy the packages of their foreign competitors in order to gain their share of the world's business.

Incidentally, that one mill is turning out no less than 420 different kinds of wrapping paper, lots of them for export. "When the war began we were making two grades of a certain variety, each in seven weights, or 14 separate sorts of paper," the manager told me. "The War Industries Board reduced the number to five, which effected a real economy for us. As soon as this emergency branch of the Government was discontinued, the paper trade, instead of going ahead with the five lines, increased the number to 19! So, of course, we have to supply them."

An Export Order and Its Result

He went on to say that before this mill had become interested in export orders he had found it almost impossible to develop an ambitious spirit among his employees. "We tried almost everything imaginable to induce the man lower down to aspire to the job higher up," he said. "Every now and then a bonus was given. Working conditions were improved. Many welfare plans were introduced. And still Henry Jones, receiving $15 a week, was satisfied to keep on drawing that amount instead of hoping for promotion to a higher position. We were surprised one day to have a foreigner call at the mill. He was traveling through the United States and somebody had told him that we specialized in wrapping paper, a line that he handled in South America. The result of that visit was a quite respectable order. After he had placed it I gathered all our employees during the noon hour and gave them a plain talk.

"'Heretofore we have been making paper for Brown & Smith of Chicago and for the X. Y. Green Company of Omaha,' I said, 'both of them within a day's railroad ride. Once in a while our shipments to them have needed a little adjustment, which we could make easily and quickly. Now we have an order from Elsenor & Garcia, of Buenos Aires, thousands of miles from here. It's a trial order, and a pretty big one at that. I want this shipment to be all right in every respect. Each and every direction of the customer must be followed absolutely. There's not to be any comeback on it!'

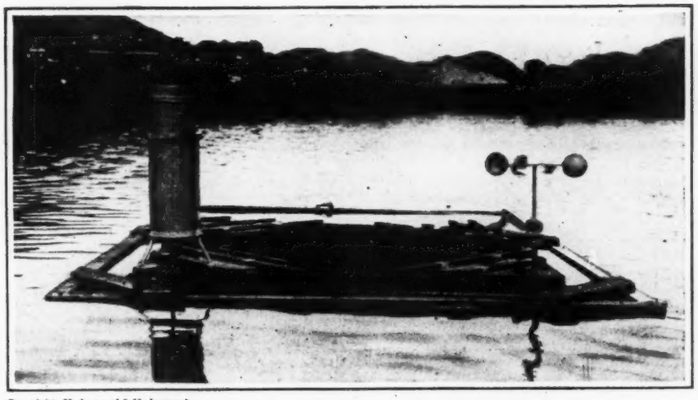
"You would be surprised at the effect of those remarks. The men formed in little groups and I could see that they were decidedly interested. The paper that went to Argentina was exactly what Elsenor & Garcia had specified, through their representative, and it was packed just right. Other orders followed; our export business grew. In the reading room that we established for our men we placed a number of books on exporting. They immediately became popular. Now we feel that the proper incentive to climb the ladder has been found."

(*Continued on page 418*)

Measuring Evaporation at the Panama Canal

IN order to study water supply conditions at the Panama Canal an evaporometer has been established at Gatun Lake. This is a copper pan, four feet in diameter, which is kept full of water and the quantity of water that has to be added from time to time measures the amount of moisture that is taken up by the atmosphere. The pan is carried by a raft which floats on the surface of the lake. At one side of the raft there is an anemometer which keeps a record of the wind while on the opposite side is a rain gage.

Evaporation at Gatun Lake is very copious, despite the high humidity of that region. During the eight months of the rainy season it amounts to four inches per month and during the four dry months seven inches per month. It must be remembered that even in the dry season there are rains practically every day, and yet the evaporation is almost the same as that of the Salton Sea despite the arid surroundings of the latter body of water. The high evaporation at Panama is due to the heavy winds which are constantly blowing there.



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The evaporation station at Gatun Lake

Peace Uses of Gas Masks

AMONG the many articles of war equipment that have little or no use in time of peace, gas masks hold a prominent place. Being of rubber they will not keep for an indefinite period of time and they cannot be stored away for use in some future war. Accordingly our soldiers are allowed to keep their masks as mementos of the great war, and the public can buy them as souvenirs from the Chemical Warfare Service.

There is the danger, however, that these masks may be put to uses for which they are not at all adapted. It is quite natural for the public to assume that masks which have stood up against all the deadly poisons which German cunning could devise to overwhelm our men, would surely afford adequate protection against any gas that might be encountered in our industries. But such is not the case. There were certain gases which the Germans could not use because they are so light that they would rise quickly and would readily be dissipated in the atmosphere. There were many limitations imposed by war conditions and hence it was impossible to use some poisonous gases and fumes which are commonly found in chemical works. Furthermore, it was never possible to obtain in the open battle field the high concentration that is often to be found in enclosed places.

The present filling of the canisters gives no protection against carbon monoxide and practically none against ammonia fumes. The Chemical Warfare Service does not guarantee perfect protection in heavy smoke such as is sometimes produced in a burning building, since no tests have been made in that line, but undoubtedly it would be of considerable service in such conditions.

The life of the cannister filling is also a problem. It is believed that if kept in a dry place it should be of considerable protective value for a year, but the only way of being sure is to test the helmet in a gas-filled room. If it fails a new canister may be purchased from the Chemical War Service. Evidently the use of military gas masks in industrial service is not without hazards and the public is warned to be mindful of their limitations.

If gas masks are purchased for industrial use they should not be bought second-hand from returned soldiers but new from the Chemical Warfare Service, and advice should be sought from the service as to the adaptability of the mask for the particular purpose in view.

The accompanying photograph illustrates the wide variety of masks used and designed for use in the war.

Sitting left to right—1. German gas mask. 2. Russian gas mask. 3. Italian gas mask. 4. British gas mask for motor-truck drivers. 5. British airplane respirator. 6. Experimental mask with metal face-piece. *Middle row*—7. First emergency method put into practice after the initial gas attack in April, 1915. 8. British "P.H." helmet, emergency type first used in 1915. 9. British box "respirator," standard type used by British army. 10. French M-2 mask, original French type used until Spring of 1918. 11. Original French artillery mask. 12. French "A. R. S." mask, last type used by French army. *Top row*—13. Original American navy mask. 14. American navy mask, final type. 15. American "box respirator," a type used by U. S. army throughout the war. 16. American A. T. mask, all rubber mask, in limited production at end of the war. 17. American K. T. mask, sewed fabric mask, in limited production at end of the war. 18 and 19. American "model 1919" mask, improved type ready for production when armistice was signed.

Gas masks used by American, Allied and German armies

Automatic Wireless Receiver Which Anyone Can Operate

THERE is much of the proverbial needle-in-a-haystack problem in modern radio telegraphy and telephony. Obviously, if the wireless laws require transmitters to be sharply tuned, it becomes necessary for receivers to be just as sharply tuned or adjusted to receive the incoming waves. This means that the operator must constantly manipulate his inductances and capacities and other receiving components so as constantly to scour the entire range of radio wave lengths. Only in this manner does it become possible to detect all calls and messages, whether they be of a military, commercial, or emergency nature.

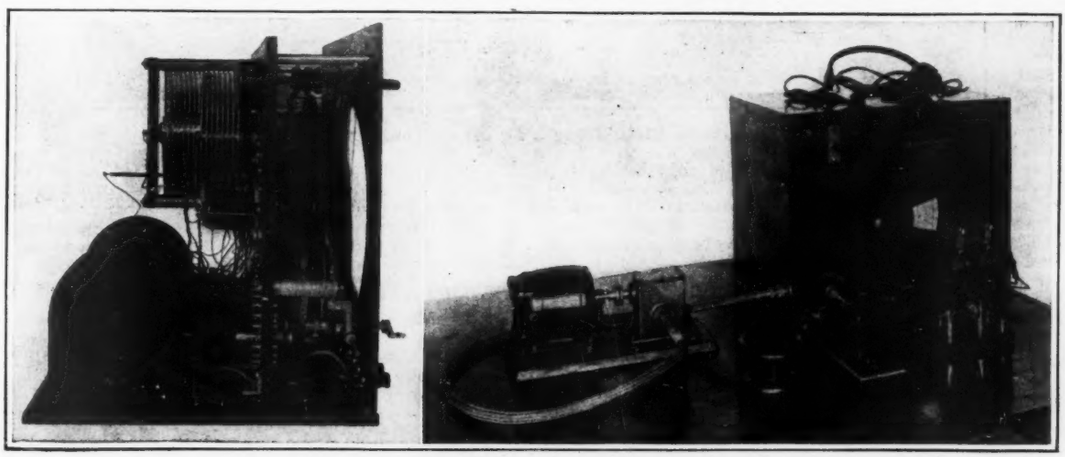
Fully realizing the possibility of a vessel calling for help on any arbitrary wave length, and not being heard by operators in the immediate vicinity because they would not happen to be searching through all wave lengths at that moment, the framers of the radio laws have made it compulsory for vessels to operate their transmitters either on 300 or 600 meters. In this manner, they believed, all wireless operators would be certain to hear distress calls within their range, for the reason that they only had two places on their sets at which to "listen in." However, the framers of the laws of the London Convention, in 1912, also insisted that the transmitters should be sharply tuned. Thus it now happens that numerous stations in the same locality may be sending on the same wave length, with the result that much interference is caused. As matters have heretofore stood, therefore, it has been a matter of deciding between finding the proverbial needle in a haystack by permitting transmitters to use any desired wave length, or inviting undue interference by insisting on the use of one or two standard wave lengths.

It has remained for Roy E. Thompson, a radio engineer of New York City, to develop an automatic receiving set which makes it possible to explore through all the wave length ranges so that any transmitter may be detected without undue trouble on the operator's part. In other words, using the sharpest tuned receiving circuit which makes for the most efficient results, Mr. Thompson employs an electric motor for manipulating the receiving components, from the lowest to the highest range, at regular and recurring intervals. In fact, his receiver may be likened to a searchlight: the motor-driven receiving set "sweeps the ether," so to speak, in the same way as a searchlight sweeps the horizon. This means that there must be a gradual and continuous sweep from the shortest to the longest wave length within the range of the instrument. Thus all wave lengths are tuned for in the course of a cycle of operation; and when the operator detects signals which he desires to receive at length, he can stop the operation at that point as long as may be necessary.

Briefly, Mr. Thompson's automatic receiving set, or uni-control receiver, as he calls it, consists of a more or less conventional circuit comprising inductance varied by many turns and by single turns at one time, a large variable condenser, and the usual telephone receivers, the fixed condenser, detectors, and so on.

The switches controlling the inductances, together with the condenser, are continuously operated by means of a train of gears driven by an electric motor through a flexible shaft drive. Thus the combination of inductance and capacity is such as to

(Cont'd on page 417)



Interior and exterior views of the automatically-operated receiving set

The Motor-Driven Commercial Vehicle

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles.

A Modern Gypsy Caravan

A RESIDENT of Los Angeles decided he would like to tour the United States gypsy fashion, yet he disliked to forego the pleasure and comforts of home. The problem was solved to his satisfaction by designing a special van body and installing it on a light truck chassis. The body is unusually commodious and as may be seen by referring to accompanying illustration the vehicle is practically a house on wheels. The body includes a large living compartment that may be used as a sleeping room at night, a kitchenette and a bath and is nearly as roomy as many a metropolitan apartment. Despite the large size of the vehicle, it is light in weight and is capable of attaining speeds of 25 miles per hour when running over good roads. The driver's compartment is well enclosed and serves as a front hall or entrance to the body.

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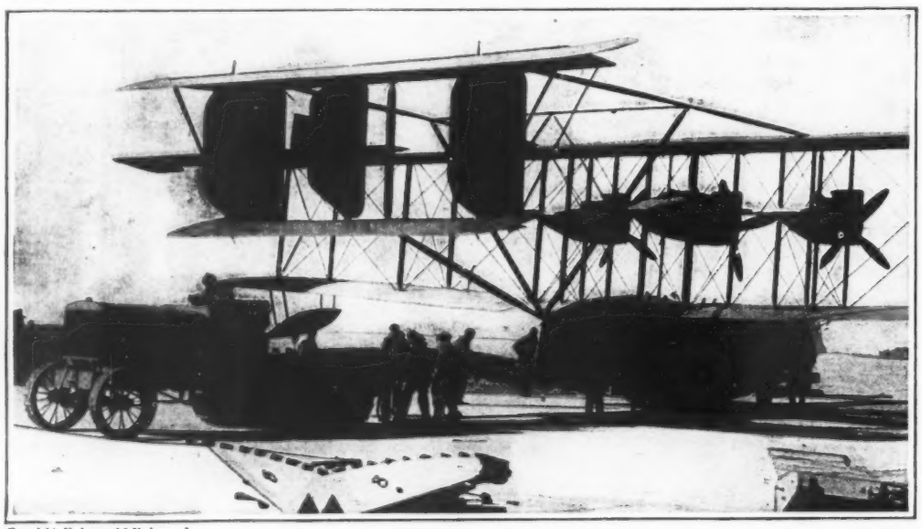
A house body mounted on a light truck chassis

Tractors for Hauling Airplanes

THE airplanes that were available at the outbreak of the war were not very large or heavy and could be easily handled by few men and moved around even on soft ground, without great difficulty. A great advance has been noted in aircraft design and airplanes of the triplane type with 120-foot spread and flying boats of even greater size are now commonplace. The weight of these large craft precludes any attempt to maneuver them by man power, yet they must be brought out of their hangars to the flying field and returned to their resting places when they have completed their flights. Horses and automobiles were tried and found wanting, so agricultural tractors of the track laying type were finally resorted to and were found ideal for the purpose.

The night bombing squadrons equipped with Handley-Page machines on the Allied front all had a small tractor as part of the maintenance and operation supply outfit and a very important adjunct they proved to be in towing huge machines weighing tons around on the muddy fields of France. The track laying tractor is ideal for this purpose because it provides the maximum traction without cutting up the surface of the field, as a wheeled tractor would when cleated or spiked traction members were employed. The accompanying illustration shows the utility of a tractor-truck having track laying traction members when applied to hauling out one of the large Navy biplane tri-motored flying boats. As this boat is reputed to have flown with 50 passengers, it is evident that its weight is considerable. A special wheeled truck is used in hauling out to support the hull and runs on tracks made of boards laid on a concrete runway. The tractor shown moves the heavily loaded truck with ease, thus saving valuable man power and reducing liability of damaging the airplane structure, which might result if it was handled by a gang of men.



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A tractor-truck hauling a big seaplane to its hangar

Heavy Traffic on New York Streets

IN an address before the American Road Builder's Association, C. M. Pinckney, Chief Engineer of Highways for the Borough of Manhattan gave some figures that are interesting in connection with the heavy traffic under his charge.

The average weight which the Manhattan engineers have found was imposed on these streets is from 100 to 200 tons for each square foot of surface on moderately used highways, such as Spring and Worth Streets, the Bowery and Central Park West. On such streets as Chambers, Canal, Hudson and Lafayette the weight is from 200 to 300 tons, and on the more congested thoroughfares, West, South and Delancy streets and parts of Eighth Avenue, the load averages from 300 to 400 tons. At some periods of the day for a period of eight hours, West Street averages a weight load of 500 tons, while the busy section of Fifth Avenue, north of 23d Street, averages 550 tons in Winter, dropping to about 250 tons in Summer.

"The enormous increase of traffic on these busy streets," said Mr. Pinckney, "is making the problem of producing strong foundations for the road surface a most serious one. Of the three types of foundation material, namely concrete, old stone pavement, and macadam, concrete gives the best results. Manhattan Borough has 354 miles of road surface laid on concrete, 101 miles on stone and two miles on macadam. Concrete foundation is laid to a depth of six inches, and the average breakage or caving in has increased slowly in the last five years, having been 5/100 of one per cent in 1913, 8/100 of one per cent in 1917, and 12/100 of one per cent in 1918."

The annual cost at present to restore these caved-in sections is about $30,000, Mr. Pinckney explained. The highway department has considered the advisability of making the concrete depths thicker, but to do this it was found that the initial cost would range from $100,000 to $200,000 and solely as a matter of economy the city authorities have deemed it wiser to repair the breaks at $30,000. The road problem of New York is rendered all the more difficult, Mr. Pinckney pointed out, from the fact that about 150,000 square yards of road surface is torn up every year for repairs to conduit systems beneath the roadways.

Power Street Sweeper

THE authorities of Boise City, Idaho, use power street sweeping machines of special design that are each capable of doing the work of three animal drawn outfits and corresponding gangs of workmen for operating and removing the sweepings. This is a gasoline engine driven street cleaning mechanism that sprinkles, sweeps and collects the refuse over a path eight feet wide and travels at the rate of four to six miles per hour. The slower speed is used in congested districts or when there is considerable refuse to be removed, the higher speed in residential districts where there is less dirt and where the streets are apt to be smooth. It is said that this machine has a capacity of 50 miles of pavement, eight feet wide in eight hours and the cost of accomplishing this work is about $2 per day.

The engine is rated at 45 horse-power and drives the front wheels, which are of extra wide tread and are used only as tractive members. Steering is accomplished by the single rear wheel which is mounted in a special fork construction. As the machine runs on three wheels, it can turn around in a very small circle. The broom and elevating mechanism are carried between the wheels. The engine has four cylinders with a bore of 4½ inches and delivers its rated horse-power at 1,500 revolutions per minute. The transmission system includes a 50 horse-power clutch, a three-speed selective sliding gearset with differential included in the same case or housing in which the broom and conveyor shaft gears operate. The broom and elevator have two speeds independent of that of the machine. The broom has a diameter of 34 inches when new and can be worn down to a diameter of 21 inches before it ceases to be effective.

The water tank may be filled from any convenient hydrant once or twice an hour and the distribution can be regulated by varying the air pressure which forces the water through the medium of a hand wheel placed conveniently to the driven seat. The sweepings are held by a hopper which has a capacity of about three cubic yards, which is said to permit an hour's run under average conditions and can be easily emptied when filled by a dumping lever at the driver's feet. The dirt conveyor is a revolving belt, extending the full width of the broom. The cost of cleaning has been reduced from 33 cents per 1,000 square yards to 12 cents by the use of this machine.

Hauling "Kosher" Meats by Motor Truck

A RATHER unusual, but no less practical use of the motor truck is the solution of a perplexing problem in meat delivery. This consists of hauling "kosher" meat from the abattoirs in Philadelphia to the Jewish markets of New York's downtown districts. There is need for haste in this work because the meat must be delivered to the retailer within twelve hours after it leaves the butcher's hands as the religious rule is that it must be eaten within twenty-four hours of the killing to be strictly "kosher." The truck running time between Philadelphia and New York is 10 hours so it will be evident it takes some speed to make deliveries to the "kosher" butcher shops in the 12-hour period. Great reliability of truck operation is called for and strict adherence to schedule as it would not do to have the meat turn from "kosher" to that of "trefa" because of delay, which latter condition renders the meat unsalable to the Jewish trade.

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And now these same "real people," back from the war with new laurels, have built their trenches in the Streets of Poverty in America. They well wage the fight for the poor and unfortunate at home, just as they have done for years, only on a larger scale.

The Salvation Army conducts Rescue Homes—Day Nurseries—Homes for the Helpless Aged—Lodging Houses for the Down and Outers—Fresh-Air Farms—Free Clinics.

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War Credits

IN these days when we hear so much of what the war has cost, it may serve some useful purpose if we set down in a general way a few of the things we seem to have gained. We refer to some of the gains which are of importance although secondary to the principles which have been sustained, political upheavals and geographical boundary changes.

Nearly every great war has left some beneficial imprint on scientific advancement and mechanical development. War is a time of great stimulation in many directions and new situations call for great invention. We owe credit to war for the inception of the sugar-from-beets industry, for it was only when the importation of cane sugar from the usual sources was cut off during the Napoleonic wars that France looked to the sugar beet. It was then inferior in sugar content and purity to the root now used and developed by a long process of selection, and a lot of work has been done to increase the percentage of the sugar in the beet recovered in the factories. A little while before the war sugar beets were furnishing about 60 per cent of the world's supply. So far as America is concerned the European war wrought several changes in the same industry, giving rise to the production of sugar beet seed in the United States, the perfection of beet slicing knives for the sugar factories and the recovery of potash from the waste beet molasses, all of which might never have taken place in times of peace.

The Lablanc soda process whereby soda ash is made from salt also originated in war necessity and so perfect was the chemistry of the method as originally devised that it has continued in use for a century and more without fundamental change. Its byproducts, hydrochloric acid and bleaching powder, have made it possible to continue using this process while the profits earned by its competitor—the ammonia or Solvay process—made it possible for its inventor to pay a huge ransom for the security of Brussels in the invasion of Belgium. Our Civil War is usually credited with inspiring the use of ether and chloroform as anesthetics, following which there has been a long line of experiments each designed to benefit the patient while increasing the opportunity for surgery to become completely successful. The condensed milk industry which does an enormous business was greatly advanced and the product introduced by the Civil War.

Science and the War

The European War may be credited with having awakened what bids fair to become a real interest in scientific and industrial research, and the recognition that the discovery of a few scientific facts and their practical application has a greater bearing upon the world's future than most of the politics that seem so important to many. Perhaps we may be coming into a chemical and engineering age in which friendly nations will work in closer coöperation than ever before. In July, 1915, Great Britain established her Council for Scientific and Industrial Research, since which time a large number of researches of industrial importance have been conducted. Funds have been provided for student fellowships and scholarships, coöperation secured among those engaged in the same or similar lines of manufacture and a great million-pound fund established by the government from which, under certain restrictions, pound for pound, may be contributed to those associations, conducting approved studies. Canada, Australia, New Zealand, South Africa and India have followed closely after the mother country in organizing research councils while smaller subdivisions of the British Empire are preparing to make the most of research.

In our own country the National Research Council was established in 1916 under the auspices of the National Academy of Sciences and after valuable service both before and during the war, is planning an ambitious program for continued usefulness. Steps have been taken to join with England, France and perhaps other countries in certain phases of research work and much of real benefit to industry may be confidently expected. Manufacturers are also learning the utility of science and those who maintained a laboratory whose duties began and ended with analyses and tests are now adding well-trained research men, to the end that they may not fall behind in their development work. Truly the war has taught us the value of sustained, continuing research.

Development of Inventions

Closely allied with research has been the trials which new inventions and processes received years ahead of their normal time. Several things thought impossible have been found to work and our ideas of what is impossible have changed materially. Processes which private concerns for one or another reason might not have considered, have been demonstrated under government control, and we have as a result, such remarkable performances as those of the helium plants in Texas. Without the great demand for acetone in smokeless powder manufacture it might have been years before a large plant would have worked out the technique of producing acetone and acetic acid by a series of catalytic processes from acetylene. We might have had to wait until the cost of hard wood forced the development of the synthetic method.

Development of Our Natural Resources

We have taken a new interest in our national resources, too. We know that radium bearing ores are to be found within our border and are not confined to Germany and Austria. Indeed we are informed that much of the rich "European" ore was carried there from Colorado. The Bureau of Mines with the coöperation of certain public minded citizens soon remedied the matter and established the fact that high grade radium salts could be made in America. Chromium and manganese have been produced in abundance, our magnesite has proven its worth and from American clays the glass pot makers have fashioned satisfactory pots, heretofore only made with the help of imported materials. The search has been for specific resources and funds have been available for necessary preliminary work while the emergency under which we found ourselves made success in these fields imperative. The often-traveled lines of least resistance were closed!

More recently we have learned that Iceland spar, a mineral from which prisms are cut for polarizing apparatus, is from North America and that the most useful varieties are not to be found alone in Iceland and southern Austria as had been advertised. The rough spar was merely cut and finished in Germany and then sold to us at an ever increasing price. Now we are to have American made polariscopes, polarizing apparatus, refractometers, spectroscopes and the like, nearly all of which have heretofore been imported. It has required many years of hard work, at times without material profit, to convince even Americans that microscopes could be made here and still be good. Even many of those trained in German universities now

(Continued on page 408)

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Of course, mileages of 15,000 to 25,000 are seldom obtained where tires are abused or neglected. This particular record reflects reasonable care given these tires. Nevertheless they made their good scores despite being obliged frequently to carry full loads over bad railroad crossings and through unpaved and littered streets.

The company recently announced that Goodyear Pneumatic Cord Truck Tires have replaced solid tires on all their trucks. This is both because of the endurance of the big Goodyear Cords and the fact that they have minimized mechanical trouble, lessened breakages in furniture, covered more ground, eliminated wintertime delays and reduced fuel and oil consumption.

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War Credits

(Continued from page 406)

know that they can be, and we welcome these valuable new additions to the class of scientific instruments upon which so much depends in industrial progress.

Besides discovering some raw materials and making various intermediates we have found that the American mechanic is capable of meeting any emergency and war made it necessary for many thousands to acquire skill which might never have been realized otherwise. Our machinists in large numbers, became accustomed to working within extremely small limits with maximum production so that in future the precision of our work should be much greater. Quantity production has always been the American specialty to which we may now add a higher order of workmanship.

Chemical Independence

The rapidity and completeness with which we have provided ourselves with "key" industries must give the German captain of industry the blues whenever mentioned. How long and faithfully the German scientist and manufacturer worked to convince us that we lacked raw materials, had insufficient technical skill and were without the ability to organize and manage such industries! Today we have a chemical industry which includes besides the heavy chemicals in which we have always been strong, many organic, pharmaceutical and synthetic bodies which result from research of the first order. How long we should have had to wait for such independence but for the war, no one knows. Today we have our own chemical glassware and porcelain stoneware, and fused silica. We are refining our own rare metals and whereas very little if any optical glass was produced before 1914 we are today in a position to export that essential commodity. Our dye industry has risen from a minor collection of assembling plants and those working from imported intermediates to a going concern, with some three hundred millions invested, having accomplished this development under the most trying conditions as regards labor and raw materials, some of which simply could not be had while there was need of explosives.

How would you like to hear the Chemical Foundation, Inc., discussed in Germany? It is expected that this Foundation, the stock of which is distributed among the strongest American companies, and to which some 4,500 enemy patents have been sold, will be able to prevent the dumping of German goods into our market, and to protect those American manufacturers who are licensed by it to work under these acquired German patents. Thus, through one of the most constructive pieces of work the war has brought out, the very German patents designed to protect German interests against all comers in our market, become the most effective defence in American hands, of our new industry! Any surplus earnings of the Foundation, after the preferred stock is retired will be devoted to research, thus greatly strengthening the very industries the German product patents were cleverly designed to kill. The war is surely responsible for such lasting benefits.

Fixation of Atmospheric Nitrogen

A new process for the production of cyanide, upon which chemical so many mining, plating, cleaning and hardening methods depend, has experienced commercial development, while the fixation of atmospheric nitrogen has received encouragement in our country in a measure which only a war or extreme necessity could impart. The synthetic process, nitride, cyanide, cyanamid and arc have all been considered and most of them tried while more than seventy-five millions have been invested in plants operating by two of the methods. By-product coke ovens have proven their worth and are gradually gaining on the wasteful beehive. In 1917 the beehives gave us 33,167,548 tons of coke and 30,405,000 in 1918, while in 1917 the by-product ovens produced 22,439,280 tons and 26,264,000 in 1918. The war has increased the demand for by-products and has shown the economy of stripping certain values from illuminating gas.

American Potash

And what of our infant potash industry? True, fumes and dust were being precipitated from cement mill flues in order to protect surrounding vegetation, but it has taken the war to encourage a spread of the practice and to arouse interest in making potash a valuable by-product of blast furnace operations, winning it from alunite and developing by-products from kelp, which may make it possible for the potash-from-kelp industry to survive in normal times.

In Germany cellulose chemistry must have made great strides for wood constituted about the only source of this building material of nature, the form of which has always exerted such an influence upon civilization in each locality. Explosives from wood in place of cotton, paper textiles, wider use of hard fiber—all go back to the chemistry of cellulose. Here, to conserve fats, we learned how to make glycerine by the fermentation of glucose or starches the end products being alcohol and glycerine, and the cheap process seems to have come to stay. It required a war to fully quicken such inventive genius.

War Gases and Peace Industries

The war led to a real study of gases and now we know something of their use, control, production and how to handle them with safety. This will lead to better protection in mine rescue work, in fire fighting and in applying disinfecting measures. There should be less danger in handling ammonia where a concentration of 4 per cent in the air soon produces a burning of the skin. We have, throughout the country, more men who know something of gas technique and can act as new centers of information. Then we have made the acquaintance of new gases which seem to have commercial possibilities. These gases are available in quantity for experiments and that always means new uses. Thus phosgene which used to cost about $1.50 may now be had at say 10 cents at which figure it becomes attractive for such uses as the removal of iron from sand wanted for optical glass. Phosgene (carbonyl chloride), does not attack pure iron, but it removes the oxides by reducing them and they pass off in vapors of iron chloride. Even small traces of iron cannot be permitted in sand for optical glass due to the greenish color iron imparts and this method for its elimination seems promising.

It is also barely possible that some gases may be useful against rodents and the like, their disappearance from the trenches being one of the few blessings of a gas attack.

Dried Foods

As the Civil War encouraged condensed and evaporated milk so the European war has introduced dry milk to many although the knowing ones have been using it for years. Properly dried milk is easily soluble, contains all the mineral salts of the milk, the lactose, the protein and as much fat as may be wanted as well as the vitamines unchanged in the drying process. It is concentrated, cheap food of great promise and a rapidly approaching necessity for the majority of those in densely populated areas. Dehydrated vegetables, many as yet imperfect, are also upon us, aided by war, and we may soon learn the advantage of saving about 80 per cent in volume and 90 per cent in weight besides spoilage, etc., over our present methods.

And where chemistry, physics, mechanics, biology and mathematics coöperate, a long list of war achievements which have come to stay. The wireless telephone created as a war device, and applied in directing our fighters in the air, is now having trials over hundreds of miles and

(Continued on page 415)

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A policy in the Hartford Fire Insurance Company means to a large degree insurance *against* fire. Insurance against fire is a very different thing from fire insurance.

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Recently Patented Inventions

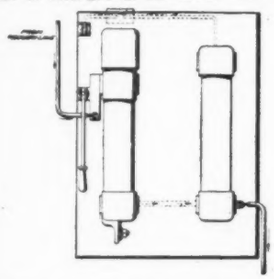
Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farming Implements, Etc.

Pertaining to Aeronautics

AIRPLANE GUIDING AND BOMB-DROPPING APPLIANCE.—E. E. HENDERSON, Hallowell, Kans. The invention relates to an appliance whereby an observer can communicate to his pilot, by an indicating device, the manner of guiding the airplane for bombing or photographing any target or other selected place, the apparatus including a telescope sight which the observer maintains on the target and thereby operates an indicating device which is conveniently positioned to the pilot so that he may steer the airplane in the proper course.

Electrical Devices

FUSE.—G. DENMAN and F. F. LEWIS, 226 So. 13th St., Terre Haute, Ind. This invention relates to electrical fuses and has for its object to provide a fuse consisting of a primary and auxiliary fuse so arranged in the circuit that when the



A FRONT VIEW OF THE PRIMARY AND AUXILIARY FUSE

primary fuse is burned out, the current will be automatically transferred to the secondary auxiliary fuse, without any interruption to the service.

LOCKING MASTER SWITCH FOR ELECTRIC SYSTEMS.—A. M. GULAMERIAN, 473 Morris Ave., Summit, N. J. Among the principle objects which the invention has in view are, to provide a locking system for an electrically equipped motor-driven vehicle for selectively setting the system to permit the use of certain parts of the equipment and to prevent the use of the remainder thereof, and to provide means for operating several swicthes in groups.

Of Interest to Farmers

PEANUT DIGGER.—V. P. MCKINLEY, care of University of Alabama, Ala. The invention has for its object the provision of a device especially designed for harvesting peanuts and the like wherein a supporting frame is provided having digging mechanism and conveying mechanism for receiving the vines from the digging mechanism, and dropping mechanism to which the vines are delivered and from which they are dropped at regular intervals.

Of General Interest

DESK.—H. G. SHIRLEY, 410 Geneva Ave., Highland Park, Mich. The invention has for its object to provide a desk especially adapted for use with stenographers and typists. The desk consists of a body portion and wings extending rearwardly and outwardly, the rear edges of the

A PERSPECTIVE VIEW OF THE DESK LOOKING FROM THE FRONT

wings and body forming a continuous curved line and the front edges meeting at equal obtuse angles, one of the wings having a depressed table for receiving a typewriting machine, the top of the wing adjacent being fixed, while the tops of the other wing and body are hinged to open.

BOTTLE SEAL.—L. ARNHEIM, care of Hugo Cahn & Co., 257 W. 17th St., New York, N. Y. The object of the invention is to provide a construction which will positively seal the cork and which is easily connected with the neck of the bottle. A more specific object is the provision of a seal having a head, two sets of arms and two necks connecting the arms and the head with one set of arms so that the parts may be properly folded over the bottle and the stopper regardless of the position of the stopper.

BABY WALKER.—R. NOEL, SR., Dubois, Pa. The invention has for its objects to provide a baby-walker in which the baby may travel back and forth longitudinally of the structure for which purpose there is provided an elevated floor, together with a spring-suspended seat disposed above the floor and carried by a slide adapted to travel back and forth. The structure is in knock-down form. The frame at the ends includes tables for the baby to either feed or play at.

PROCESS OF MAKING ORNAMENTS.—R. FRITSCHE, 584 E. 164th St., Bronx, N. Y. The object of the invention is to provide a construction and process whereby a substantially non-fragile ornament may be produced for use as a decoration on a Christmas tree, or on clothing. A further object is the utilization of a method whereby hollow members may be formed from molten glue and then inflated to the desired size and coated with coloring matter.

WINDOW FLOWER BOX.—A. E. HURST, 435 W. 119th St., New York, N. Y. The invention relates to window boxes for flowers allowing for the maximum of air and light in the interior of the room, to provide for a sufficient depth of soil for the plants, to construct the boxes in such manner as to receive the soil directly or to receive insert soil containers, and to provide separable units in order to adapt the boxes to windows of different widths, to provide suitable drainage and means for anchoring the box in place.

BUTTON.—C. E. STONE, 40 Rutland Sq., Boston, Mass. An object of the invention is the provision of a construction which may be quickly applied and will remain firmly in place. Another object is to provide a button which may be applied to articles of cloth without the use of threads or similar means regardless of the thickness of the goods

DISTORTION DEVICE FOR ATTACHMENT TO CAMERAS AND SIMILAR APPARATUS.—B. SMITH, care of William M. Houghton, Harvard Club, 27 W. 44th St., New York, N. Y. The object of the invention is to provide a distortion device for attachment to the objective of a photographic camera, projecting apparatus and similar apparatus, arranged to permit the user to take or project a distorted picture of a given object the distortion being under the control of the operator.

Hardware and Tools

CORE REMOVING TOOL.—S. E. CREASEY, Sanford, Me. Among the objects of this invention are to provide means for removing the core from fruit of certain characters, such as grapefruit or other citrous products, to perform the operation with despatch and neatness, to reduce the need for handling the fruit, and consequently soiling the hands, and to produce a tool of the character mentioned at a low cost.

MEANS FOR LUBRICATING MACHINE TOOLS.—W. F. MCCARTY, care of Defiance Machine Works, Defiance, Ohio. The invention relates to the lubrication of machine tools, such, for instance as horizontal boring, drilling, milling and tapering machines. The object is to provide means for lubricating the bearings, gears and clutches contained in the vertical adjustable head of a machine tool, the arrangements being such as to insure a continuous lubricating of the parts while the machine is running without requiring any attention from the attendant of the machine.

Heating and Lighting

COMBINATION COOKING AND HOUSE WATER-HEATING RANGE.—J. E. ZIMMERMAN, 618 Church St., Richmond Hill, L. I., N. Y. Among the objects of the invention is to provide a stove or range having a plurality of independent and interchangeable fire boxes or heating units, one of which is to be employed in cold weather and the other in summer weather, an oven being provided and so disposed as to be capable of being heated from either fire box or source of heat.

CAR HEATER.—E. P. COLE, care of Cole Mfg. Co., Chicago, Ill. The object of the invention is to provide a stove adapted to use either charcoal or a prepared briquet fuel, which requires no smoke pipe and which is adapted to give a uniform temperature over at least two or three days without attention, at the same time be fireproof itself and capable of use without the emission of sparks.

Machines and Mechanical Devices

LABELING MACHINE.—O. S. KUNKELY, 2120 Majes Ave., Bronx, N. Y. The invention relates more particularly to a machine for affixing labels to the opposite ends of a roll of ribbon or to the ends of a round box, carton, or the like. The general objects are to provide a machine whereby ribbon rolls for example, may be labeled speedily and economically with respect to the elements of time and labor.

CANDY COATING MACHINE.—P. P. PUPILLA, Bradley Beach, N. J. This invention relates to candy making machines, and more particularly to a machine for coating candy centers with chocolate or other coating material. The general objects are to provide a machine which is of large capacity which is primarily a candy center coating machine and is adapted to receive candy centers from a molding and casting machine, and includes means whereby the candy centers are separated from the molding material and fed to the coating mechanism.

COMPRESSOR.—R. ROLKERR, care of Sherwood Apts., 431 S. Grand St., Los Angeles, Cal. Among the principal objects of the invention is to increase the power of compression in a machine, to provide a compressor comprising a plurality of helical members of different diameters, the convolutions whereof are interleaved, and means for maintaining the convolutions in line to interrupt chambers formed by said helical members, said means embodying an enfolding casing, and means for rotating the helical members in unison.

NON-METALLIC ENGINE PISTON.—G. B. SCHOU, 105 E. 95th St., New York, N. Y. Among the objects of the invention is to provide a construction of reciprocating piston for engines, whereby the piston itself will perform all necessary functions, yet will be cheaper, quicker to make, and more reliable in action, especially in high altitudes or cold climates than the ordinary metal piston.

Musical Devices

PIANO.—P. M. BORJA, Export Sales Dept., Western Electric Co., 195 Broadway, New York, N. Y. The invention has for its object to provide a construction wherein the keys will be on the same plane or substantially the same plane as the upper surface of the body of the piano. Another object is to provide a music desk which may be folded so as to cover the keys, and a top which may be opened to any desired extent from a small to a complete hinging of the top pieces along the sides.

Prime Movers and Their Accessories

AIR HEATING AND REGULATING MEANS FOR INTERNAL-COMBUSTION ENGINES.—H. BROOKS, Box 716, El Paso, Texas. The invention relates to an air heater to be applied to an internal combustion engine for utilizing the heat generated in the operation of the engine and supplying the heated air to the carbureter to produce the fuel mixture. An object also is to automatically compensate the chilling effect of cold jacket water by an increased temperature of the intake fuel.

Railways and Their Accessories

CAR DOOR LOCK.—R. T. ROBERTS, 60 Suffolk St., Worcester, Mass. The invention relates to locks which are adapted to be mounted within the body of the door so that the locking mechanism cannot be broken to get access into the car. An object is to provide a simple strong and inexpensive lock for which a specially constructed key is required to operate the locking mechanism.

Pertaining to Recreation

SINKABLE TOY SHIP.—J. B. BLACKSHEAR, 113 Hotel St., Honolulu, Territory of Hawaii. The invention relates to toy ships having means whereby to cause submergence, by admitting water thereto, the inlet of water being controlled by displaceable valve means. A further object is to provide for release of the valve means by the hitting of a target which simulates a boat swung in supports generally suggestive of davits. The invention also provides a trigger engageable with the target so arranged that the setting of the trigger permits the valve to automatically close for maintaining the ship in floatable condition.

Pertaining to Vehicles

SAFETY LOCKING DEVICE FOR VEHICLES.—E. R. MOORES, 1001 Court St., Portsmouth, Va. The invention relates to automobiles, auto-trucks, airplanes and similar vehicles using internal combustion engines as the motive power. An object is to provide a safely locking device to prevent unauthorized persons from starting and running the motor, and to sound an alarm whenever an unauthorized person tampers with the locking device, the device may be fitted to vehicles now in use without materially altering the construction.

VEHICLE TOP.—D. F. OLIVER, Dec'd, 2610 E. 14th St., E. Oakland, Cal. The object of this invention is to provide a vehicle top more especially designed for use on automobiles arranged to keep the covering properly stretched to permit adjustment, expansion and contraction, to permit the operator to easily raise and lower the top and to keep the rear portion of the top extended over the rear part of the vehicle, while the front portion is folded up out of the way of the occupants of the vehicle.

TRACTOR ATTACHMENT FOR AUTOMOBILES.—M. L. ADAMS, 910 Stewart St., Seattle, Wash. The prime object of the invention is to provide a particular attachment for application to an automobile in place of the rear wheels whereby to drive the automobile over snow and ice with the front wheels supported on shoes or sleds or to propel the automobile on muddy, sandy, or similar roads.

DIFFERENTIAL.—C. H. BROWN, care of Brown Welding Co., El Paso, Texas. The invention relates to differentials for motor vehicles, its object is to provide a device wherein the sections of the axle are connected by a worm gear to permit a slow differential movement without undue resistance, while turning a corner, for instance, but which will prevent the axle sections from turning readily with respect to each other.

WHEEL RIM.—F. F. TAYLOR, care of Peoples Lumber Co., Belen, N. M. The object of the invention is to provide a wheel rim more especially designed for use on wheels of automobiles, auto-trucks, and similar power-driven vehicles, and arranged to permit the operator to quickly collapse the rim for placing a tire in position or removing it thereform whenever desired.

SHORT TURNING GEAR FOR TRAILERS.—A. ARATO, Turin, Italy. The invention has for its object to provide a device which can be applied to four-wheel cars of the usual type, that is having a fixed rear axle and a front axle rotating as to the car, for the purpose of making the said car when used as a trailer, to travel exactly in the track of the tractor.

TIRE CASING.—C. W. MIEGEL, 517 Bergen Ave., Jersey City, N. Y. An object of the invention is to provide a tire casing of puncture and blow-out resistance and heat minimization. Another object is to provide a casing formed of inner and outer sections, except along the lines

TIRE CASING

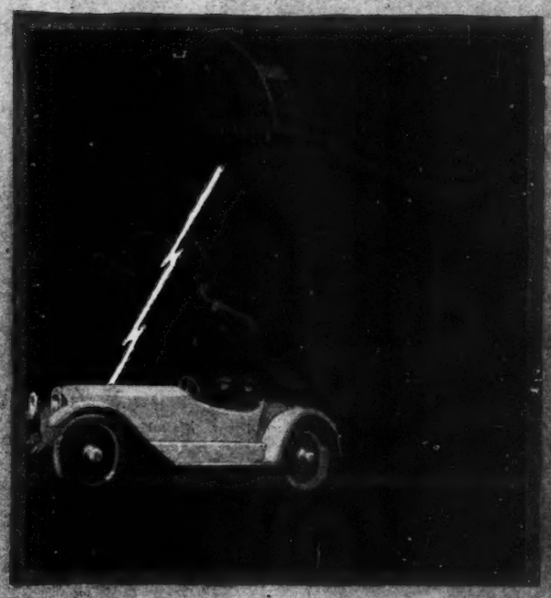
adjacent the base of the casing, where they merge to form the clencher beads, whereby to define a space between the sections in which powdered graphite or other dry lubricant is received, and to provide armor means for the casing.

SPEED MEASURING AND CONTROLLING DEVICE.—J. H. CORE, 311 Sixth Ave., Nashville, Tenn. The present invention relates generally to a device for measuring speed and controlling speed of vehicles, more particularly to improvements upon patent No. 1,110,900 granted to the same inventor, the object being to provide a more simple, generally effective construction.

MOTOR VEHICLE.—A. R. CARTER, Hammond, La. This invention relates to vehicles of the steam driven type, wherein each rear wheel is connected directly with a pair of reciprocating pistons, and wherein a boiler is provided for supplying steam to the pistons, the supply being controlled by the steering of the vehicle to enable a differential to be dispensed with.

LIGHT REFLECTING HAND SIGNAL.—G. B. MULLEN, Bell Ave., near Broadway, Bayside, L. I., N. Y. The invention relates to a signal device that is adapted to be worn on the hand of a driver of an automobile or other vehicle. The object is to provide a light reflecting signal mounted in a holder which is attached to the hand, the signal being in the form of a crystal which becomes illuminated from rays of light shining thereon, as from a lamp on the vehicle in which is the driver who has the light reflecting hand signal.

PRESSURE DEVICE FOR VULCANIZING RUBBER VEHICLE TIRES.—D. E. BOOTH, Box 1728, Tulsa, Okla. The invention relates particularly to vulcanizing wherein the heat is supplied by a vulcanizer located within the tire. The object is to provide a flexible easily detachable pressure device capable of adaptability to all sizes or diameters of tires and in which the tire may be placed and vulcanized without leaving marks or ridges upon the surface.



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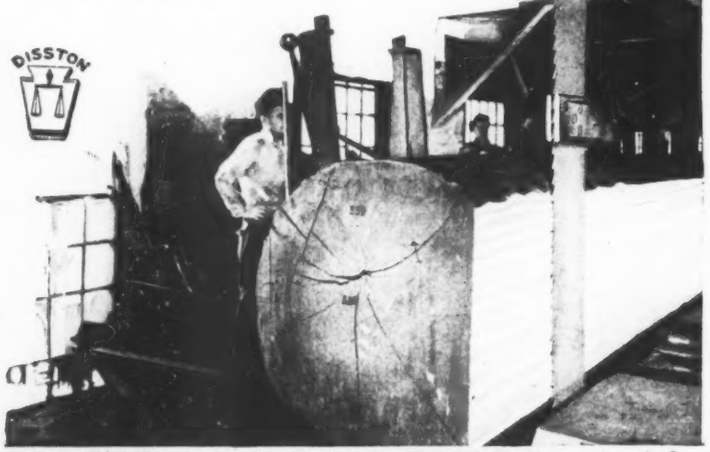

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Of Interest to Farmers

TRACTOR.—C. E. WAKE Waitsburg, Wash. An object of the invention is to provide a tractor which is especially adapted for use in districts which are hilly, the tractor being provided with a leveling wheel which will permit the device to easily run on the side of a hill, the raising or lowering of the leveling wheel being accomplished either manually or by power derived from the engine of the tractor. A further object is to provide a tractor whose wheels are provided with removable shoes made of angle iron which prevent the slipping of the device in a side-wise direction.

TRACTOR DRIVE.—S. W. PIPKIN, Box 36, Cland, New Mexico. The invention relates to a friction drive more particularly intended for embodiment in a tractor drive. The prime object is to provide a drive means involving friction pinions and friction disks to be engaged thereby and in which an effective driving engagement is insured between the pinions and the engaged disks, and means controlling the pinions to vary the speed or to reverse.

HARVESTER.—A. R. MILLER, Denison, Iowa. This invention relates to grain harvesters, and has for its object to provide means, in connection with the draper of a binder or other harvester which receives the cut grain from the sickle, for retarding the headed ends of the straw for insuring the even placing of the cut grain on the draper.

MOTOR PLOW.—K. KUCHARSKI, Box 566, Thurber, Texas. The prime object of this invention is the provision of a plow provided with a spring actuated motor driving device, the latter being rewound for use by the hand of the operator without leaving the driver's seat. A further object is to provide a plow having a pluraity of mold-boards and provided with an inexpensive motor means eliminating the use of draft animals whereby the motive power will be without cost, a single operator completely manipulating the device.

Of General Interest

HAT RACK.—A. H. KNIGHT, 1118 Hudson St., Hoboken, N. J. Among the principal objects which the invention has in view are to provide an article constructed of metal, adapted to be hung from the ordinary picture moldings provided in houses, the device may be readily dismantled and packed within small compass, and is adapted for service at different heights.

ATTACHING SOCKET FOR GAS TUBING.—R. C. LEWIS, 176 Remsen St., Brooklyn, N. Y. The object of the invention is to provide an attacking socket for tubing arranged to prevent the elastic rubber tips of the attaching socket from accidentally slipping or being pulled off from the gas nipple thus preventing escape of the gas. Another object is to reinforce the elastic tubular tip to prevent the same from becoming detached.

FLUSH TANK VALVE.—E. R. HILL, New Albany, Miss. This invention which relates to flush tank apparatus, has particular reference to the automatic valves for controlling the inlet supply pipes of such devices, the invention constitutes an improvement on the structure covered by Patent No. 1,257,231 issued to the same inventor February 19th, 1918.

BUILDING OR CASTING OF STEEL-CONCRETE SHIPS.—N. K. FOUGNER, Christiania, Norway. The invention relates to the casting of steel concrete ships of middle size, ships varying from 150-750 tons. Ships of this size generally have walls which are too thin to permit their being cast between ordinary double lathing, consisting of wood or metal lath. By the present invention the walls are cast between an outer lathing of metal netting and an inner lathing consisting of horizontal boards guiding in vertical slots in the frame.

CANTEEN HOLDER.—G. C. WELTER, Box 5, Roswell, N. M. The invention relates particularly to means for strapping the canteen to a support. An object of the invention is to provide a simple and inexpensive holder which will retain the canteen firmly on its support and prevent the rattling of the canteen during the motion of the body by which the support is carried.

WATERPROOF CROWN FOR WATCHES.—M. J. GOLDEN, 939 St. Marks Ave., Brooklyn, N. Y. This invention relates more particularly to means for preventing the entrance of moisture into the watch case at the winding and setting stem. A specific object is the provision of a simple crown and clamping and unclamping means to normally hold the crown seated in watertight condition, and to permit the crown to be released when the watch is to be wound or set.

WATCH.—M. J. GOLDEN, 939 St. Marks Ave., Brooklyn, N. Y. The object of the invention is to provide means for sealing a watch against the penetration of moisture about the winding and setting arbor. Provision is made whereby the arbor can be sealed under sufficient pressure to absolutely prevent the admission of water, but can be relieved readily from pressure to permit it to be rotated for the purpose of winding or setting the watch.

METHOD AND APPARATUS FOR CLEANING TRIPE.—C. S. HARDY, 710 6th St., San Diego, Cal. The invention relates to butchering and more particularly to methods and apparatus for cleaning tripe, the method consisting in introducing tripe into a receptacle containing water, causing the tripe to travel through the receptacle in a vermiform course, imparting a tumbling and scraping action to the tripe during such course, and carrying off by floatation extraneous matter freed from the tripe, the work being done mechanically instead of by hand.

FOLDING COT.—J. LUPPINO, 1608 85th St., Brooklyn, N. Y. The invention relates to furniture, its object is to provide a folding cot which can be readily folded to take up very little room for storing, shipping or other purposes, or which can be extended without much physical exertion on the part of the operator, the cot when in extended position having its parts securely locked to prevent accidental folding.

COLLAR BAR.—S. SAMPSON, 2 E. 23d St., New York, N. Y. Among the principal objects of the invention are to provide simple means for preventing failure of the meeting ends of a collar to hold the collar firmly, to avoid marring the exposed surfaces of the collar where it is gripped by the bar, and to provide means for holding a necktie in proper position.

HOLLOW CORNER BLOCK.—F. HEATH, 1001 McCormick Bldg., Chicago, Ill. The invention relates to hollow corner blocks for use in hollow wall construction. An object is to form a block for constructing corners of walls, jambs of openings, and for building piers, which will make a more sightly corner than blocks in common use, and will give a greater strength when built in a wall than ordinary corner blocks now used.

POWDER CONTAINER.—O. E. ANDERSON, JR., 486 Commercial St., Astoria, Ore. The invention relates more particularly to a dispensing container for various uses, the object being the provision of a container including means whereby the dispensing operation may be accomplished readily and quickly, and a proper supply of powder ascertained and readily maintained at all times; the device may be mounted in connection with a wall bracket and the like at any convenient point.

LADDER STAY.—J. MAXWELL, 108 W. 43d St., New York, N. Y., care Elk Club. The invention has for its object to provide a construction of stay member capable of attachment to substantially any ladder and of adjustment to coact with the lower end thereof to prevent sliding. Another object is to provide a stay so formed as to be rotatably mounted on one of the rungs whereby the supporting leg of the stay may be offset in proportion to the angle of the ladder.

COMBINED FIELD GLASS AND RANGE-FINDER.—B. R. JOLLY, 128 Fayetteville St., Raleigh, N. C. An object of the invention is to provide a combined field glass and range finder which can be used for one purpose or the other, or both, and which does not take up any more room when folded than an ordinary telescope. A further object is to provide a field glass and range finder in which the range may be approximately determined by a single observer, and a device of such form that it may be folded and stored away in the pocket.

REINFORCING ELEMENT FOR CEMENT AND CONCRETE WORK.—F. G. JORDAN, 306 Indiana Ave., Washington, D. C. The invention relates particularly to a reinforcement for walls and structures of concrete, capable of effective efficient fabrication without the use of bolts and other connections, and without requiring particular tools or especial skill in connection therewith. An object is to provide interstices therethrough for the cement or concrete whereby to form a strong union and effective bond.

SANITARY MILK MEASURE.—W. C. SMITH, 98 W. Lincoln Ave., Mount Vernon, N. Y. This invention relates to measuring and dispensing devices for milk; it has for an object the provision of a construction wherein an accurate quantity may be quickly measured and dispensed at the same time. Another object is to provide a measuring device which may be bodily set into an ordinary milk can and operated quickly without impairing its accuracy.

COLLAPSIBLE LEAD PENCIL HOUSING.—A. SHATKIN, 323 E. 90th St., New York, N. Y. An object of the invention is to provide a simple construction which is characterized by its rigidity when the pencil housing is fully extended. The housing comprises the sections, each formed of a pair of spaced concentric tubes united into a unit at one end, a lead grip associated with the extreme section, and a catch for engaging the extreme section when the housing is collapsed.

(Continued on page 414)

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RECENTLY PATENTED INVENTIONS

(*Continued from page 412*)

BOX WRAPPER FOR PACKAGES.—C. SCHNEIDER, 529 W. 125th St., New York, N. Y. The invention relates particularly to means for wrapping packages in laundries, tailor shops, haberdasheries, dry goods stores, or the like, where rapidity of operation is important as well as safety for the goods. More specifically stated the invention provides a combined strawboard box and sheet of wrapping paper in such manner that the supply of wrappers will be retained in flat form, thus occupying a minimum amount of space, until wanted for use.

BOOK JOINT.—F. REUTER, 214 E. 23d St., New York, N. Y. This invention relates to a book joint especially adapted for—although not necessarily limited to—books having flexible covers, the general object is to provide a joint between the book and the cover so as to materially strengthen the construction and increase the flexibility of the joint so that there is less strain thereon in opening and closing the cover.

SUBMARINE DETECTOR OR TELLTALE.—J. P. GERAGHTY, 493 Grove St., Jersey City, N. J. A specific object of the invention is the provision of a form of net which is detachably fastened to anchoring devices so that when a submarine strikes the net it can tear the latter away from the anchorage, which then cause signals or telltale means to become operative so that patrol boats can locate the position of the submarine by the signals many miles away.

MEASURING DEVICE.—E. G. BILLINGS, 316 N. 3d St., Olean, N. Y. The invention has for its object to provide a device wherein a swinging tank is provided, adjustable for various capacities, and having means for indicating the filling of the tank controlled by the overflow of the tank, as the tank fills to the level of the overflow the liquid will flow through the overflow and will eventually tip a lever causing a hammer to strike a bell giving warning that the correct amount is in the tank.

PROCESS OF PRODUCING FERROMANGANESE.—J. T. JONES, 429 Union Arcade Bldg., Pittsburgh, Pa. One of the main objects of the invention is the provision of a process by means of which ferromanganese may be produced at a relatively low cost from low grade manganese ore. A further object is to provide a process which does not require the use of specially designed machinery but which may be carried out through the use of ordinary apparatus such as a regenerative coking oven and a generative furnace.

METHOD AND MEANS FOR INDICATING THE MAXIMUM FLOW OF FLUIDS.—A. P. LITTLE, 1458 Fuller St., N. W., Washington, D. C. The invention relates to maximum demand or flow indicating meters in which a differential pressure due to the flow of a fluid causes the displacement of a liquid, a portion of which becomes entrapped in an indicating tube, the object being to provide an instrument which will indicate the maximum rate of flow of a fluid, such as water, gas, during any period of time.

FINGER RING AND MOUNTING THEREFOR FOR GEMS.—P. L. CAMBELL, Douglas, Wyo. The object of this invention is to provide a mounting adapted for use with precious stones or in correct relation while the stone is firmly held against displacement and thus a minimum surface is disclosed, and accessibility for cleaning and the like is had, wherein the usual holding prongs for gems are dispensed with.

MAIL BOX.—G. HONIG, 2726 Wellborn St., Dallas, Texas. An object of the invention is to provide a rural mail box of simple construction as well as increased accessibility for the convenient insertion and removal of the mail matter, and to provide a signal pivoted on the cover of the box, being swingable to approximately an upright position to indicate that mail is in the box

Hardware and Tools

FISHING TOOL.—C. L. NICHOLS, Ravenswood, W. Va. This invention has for its object to provide a tool especially adapted for permitting a detached joint to be firmly connected with the remainder of the casing, in such manner that the entire casing may be pulled without the necessity of releasing the detached joint until the said joint is withdrawn

ANGLE AND ARC DIVIDING RULER.—P. MILLIKEN, Elsinore, Cal. The object of this invention is to provide a ruler which may be used to trisect any angle, to construct equilateral triangles and hexagons, to divide angles into two, four or eight parts, to construct squares, octagons, etc., and for other purposes.

VALVE GRINDING DEVICE.—J. C. LOHEC, 222 Blanco Rd., San Antonio, Texas. The invention relates generally to valve grinding devices, and more particularly to an arrangement whereby the several valves of a multi-cylinder engine or motor may be simultaneously ground, the object being the provision of a simple apparatus, the structure of which provides for ready interchangeability, repair and adjustment of the working parts, as well as ready attachment of the device in operative position.

Machines and Mechanical Devices

ADDING AND SUBTRACTING MACHINE.—T. J. WAVRUNEK, Shawano, Wis. The object of the invention is to provide a calculating machine so designed that additions or subtractions can be performed by the same keys by reversing the order of manipulating the keys in adding or subtracting, that is to say, in adding a number more than ten the keys are operated from left to right and in subtracting a number two digits or more the keys are operated from right to left.

FRUIT TRIMMING MACHINE.—D. T. FLEMING, Honokohan, Maine, Territory of Hawaii. The invention relates to machines for the peeling of pineapples. The invention is characterized by means to coact with the belt in pressing the peel in proper form to the knife, and by a form of correlation of the knife, the belt, and the coaching presser means with the purpose of firmly sustaining the peel in position to be effectively trimmed by the knife and with the purpose of removing the fruit from the peel to the maximum extent.

GREASE CUP.—H. E. ARGO, 431 S. Dearborn St., Oak Park, Ill. The invention is composed of a tube or rod with a concave perforate top, upon which the grease rests, the lower end of the tube touches the shaft or axle of the machine and a spacing core or plug rests in the smaller end of the cup, a coil spring is arranged within the cup forcing the tube or rod down, the action of the spring keeping the grease soft and facilitating its quick passage.

GRAVITY CONCENTRATOR.—J. BECOTT, Box 503, Durango, Col. The object of the invention is to provide a concentrator wherein a series of gravity concentrators is provided arranged to hold the concentrates in water in a narrow deep trough and having means for retarding the flow of the concentrates to permit them to settle by gravity, and wherein mechanism is provided in connection with each trough for drawing off the minerals at a different level upon which they settle.

Pertaining to Vehicles

STABILISCOPE.—B. D. WILLIS, 254 Clinton Ave., Oak Park, Ill. This invention relates to safety appliances for use on or in connection with automobiles or other road vehicles for the purpose of determining or indicating to the driver or other occupant the condition of safety of the roadway or stability of the conveyance while passing along roadways of doubtful or precarious sidewise inclination.

HAND-WHEEL.—H. W. DOVER, Holyrood, Northampton, England. This invention relates to hand wheels such as are employed for steering motor vehicles, for opertiang stop cocks, controlling aircraft, motor boats, gun mechanism, and for other purposes, and has for its object to facilitate the assembling of the parts of the wheel, and to cheapen the cost of construction.

TAIL LIGHT HANGER.—C. F. TAYLOR, 157 W. 16th St., New York, N. Y. Among the principal objects which the invention has in view are to avoid breakage of lamps when backing a vehicle equipped therewith, to provide means for centering the lamp by guiding it to its service position, and to provide a yielding support for lamps having means for associating a license plate therewith at all times.

AUTOMOBILE WINDOW.—W. V. DAVIS, care of Marc Eidlitz, 30 E. 42d St., New York, N. Y. The principal objects of the invention are to afford opportunity for hand-signaling while driving a closed body automobile, to prevent the admission of rain or snow to the interior of the car having an opening in the side window for signaling purposes, to avoid moisture deposit on interior of the window, and to provide means for hanging a weather curtain.

Designs

DESIGN FOR A PLAYING-CARD; DESIGN FOR A SET OF PLAYING-CARDS; AND DESIGN FOR A PACK OF PLAYING-CARDS.—A. GLIDEWELL, Fayetteville, Tenn. This invention has been granted patents on the three designs as mentioned above.

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contains Patent Office Notes. Decisions of interest to inventors—and particulars of recently patented inventions.

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War Credits

(*Continued from page 408*)

is making good. But yesterday the Germans were trying to capture the mechanism intact so great was their wonderment at what could be accomplished with it. By the wider application in a commercial way of some of the submarine detecting devices, it may soon be possible to make collisions with ships a thing of the past, and disasters from derelicts, icebergs and other floating dangers, quite unheard of. The same devices may be used, also in locating sunken vessels, so that attempts at raising them may be made and in detecting the nearness and location of reefs, the shore and any object of size in the water. Such war inventions will be of permanent and increasing value.

Hydroelectric Power Plants

It is to be hoped that the war's fuel crisis will lead to a wider use of our hydroelectric power of which 3 per cent has been developed and the early introduction of the great central power plant plan which proposes more efficient use of fuel near its source and the distribution of the energy by common carrier lines. The statement is made that for every 5,000,000,000 hydroelectric horse-power put to work, we save about 17,000,000 tons of fuel annually and release for other employment 100,000 of the men who "spent their lives following coal around from the bowels of the earth to the ash pile." Italy and France are making progress in using their water power while here since 1903, things have been waiting for a few technicalities to be settled.

The influence upon our scientific teaching can hardly fail to be beneficial providing those responsible for the business management of educational institutions take account of the necessity for proper salaries. The faculties of nearly all schools have been shaken from their traditional ruts, many men have had to resume new responsibility and still others have had business and practical experience of great value. Teachers and students alike have had many opportunities for research, much of it in the great field of organic chemistry in which we Americans had not been as proficient as we shall henceforth become.

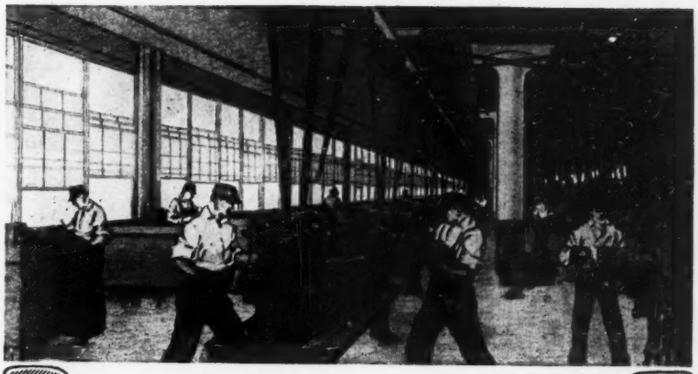
Surveying from the Sky

A host of war problems, the solution of which might mean benefits in peace, remain incompletely solved, and still newer ones have been uncovered. Thus the airplane will no doubt be widely used from now on in making topographical surveys quicker and more accurately than by older methods. Airplane cameras with lenses of 50-inch focus, and clever mechanical devices have been provided for such work, and they proved their worth on the western front, where in 1918 more than 250,000 negatives were taken by the British airmen alone. But we shall continue to have airplane problems for chemistry to solve such as a fuel for use at high altitudes, where oxygen is so scarce that gasoline will not give satisfactory combustion. Something is needed such that it will not only be a valuable fuel for internal combustion engines, but in burning will liberate oxygen for the combustion of other ingredients of the mixture.

Let us learn our lesson well and remember it. We should not require a war to awaken and stimulate us. Now that we have made a creditable beginning let us continue with full attention to coöperation, education and research. It is the discovery and application of scientific truths that count large in the world's progress.

The Current Supplement

WIRELESS telegraphy was sufficiently wonderful when it was new and imperfectly understood; what then shall we say of wireless telephony, which projects through the ether, not arbitrary signals, but the actual human voice? The developments which have brought this achievement out of the realm of dreams and



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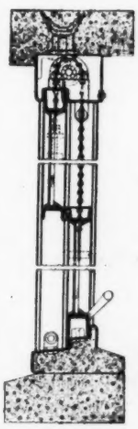

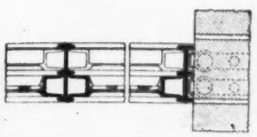

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into the domain of cold, hard facts have been concentrated in the years of the war, and as a consequence the story has never been told in connected form. A summary of the briefest sort appeared last week in these pages; and beginning with the current issue, No. 2259, for April 19th, we carry in the SUPPLEMENT the complete story of *Radio Telephony*, in three installments, as told by two of the men who have been among those active in the work. Other articles possess almost equal interest. There is the discussion of *Molecular Association and Chemical Combination*, in which a French authority gives his views as to the relation between the forces of ordinary cohesion and of chemical affinity. In somewhat lighter vein is the profusely illustrated account of *Familiar Insects through the Camera*. Mr. Hurley's exceedingly able discussion of the shipping situation is concluded. Under the title, *Mechanics and Electricity*, Professor Franklin of Technology presents an extremely striking array of analogies between mechanical and electrical action. The various answers given by scientists of various branches to the long-standing question, *How Old Is the World?* are collated and compared. Shorter discussions of interest include *The Industrial Use and Limitations of Respirators, Gas Masks and Oxygen Breathing Apparatus*, and *Widening Demand for Blast Furnace Slag*.

Floating Mines in the North Atlantic and the Arctic Ocean

(Continued from page 395)

by me in my investigation have been seen at the various points of the Atlantic Ocean here mentioned after the lapse of 10 or even 20 years. It should be remembered however, that the mines tend to disappear more rapidly than the floats because of their automatic destruction.

The coasts of the United States are protected against these instruments of danger, coming from Europe by the polar current which flows from the north toward the coast of Florida. Such are the conclusions to which I have been led by my oceanographic studies and which I now wish to apply to the safeguarding of the navigators who may still be menaced long after the signing of the articles of peace by the genius of the "frank and joyous" war.

Locating Unexploded Shells on the Battlefields of France

(Continued from page 395)

the location of fragments of shot, previous to operation. The first experiment of this sort was made in 1881 upon President Garfield; and the balance at once located the bullet, which had eluded all probing.

The "Alpha" machine of Professor Guitton comprises two large wooden rings, upon each of which are mounted two coils of wire, the one traversed by a variable current, the other in circuit with a telephone. The second coils in both cases are in circuit with the same instrument; and the connections are so arranged that the electromotive forces respectively induced in the telephone by the two variable currents are in opposite senses.

Under these conditions, if the two pairs of coils are identical, and if there is no metallic object in the immediate neighborhood to introduce perturbations, the two electromotive forces compensate exactly, and no current is produced in the telephone circuit. The instrument accordingly remains silent. But on the contrary, when the apparatus approaches anything of metal, the induced currents are such, under the modification of the magnetic field thus caused, that the electric symmetry of the system is destroyed and the telephone gives off sound.

The apparatus can be taken down for packing and transport. It is controlled by means of two small coils inserted in the circuit, capable of turning on one another; preliminary calibration is obtained by removing the outfit from the vicinity of all metals and turning the inner coil until absolute silence—which means absolute balance—is obtained in the telephone. Once assembled at the scene of action and calibrated, the operator walks back and forth over the ground to be tested; an assistant follows, carrying in a small box the induction coil which supplies the current.

In this way it is possible to discover a metallic mass of as much as 10 kilograms at a distance of 40 or 50 centimeters, or a smaller fragment at 25 or 30 centimeters. But the sound given out by the telephone is to all intents and purposes the same in either case, for its intensity is directly proportional to the mass of metal in question and inversely proportional to the depth at which this mass lies. Incomplete information is thus the best that can be had, and it becomes necessary to remove the overlying earth in every case with the care that would be employed if it were known that a grenade was buried at a depth of only a few centimeters. Moreover, operation is rather slow. Professor Guitton estimates that it would take about three hours to explore thoroughly the surface of one hectare (2½ acres); others insist that this time is altogether too short for the task. So while capable of rendering good service, the instrument is apparently not the last word in the solution of this extremely complicated problem.

The French Problem of Reconstruction—I

(Continued from page 397)

in his own town almost invariably, if she is to marry a farmer, because to marry one in the next town will be to have two farms too far apart to attend to!

To rebuild a ruined town alongside the ruins would mean that some one would have to give up his land—his cherished land.

Aye, someone—but who would do it? Why should Pierre and Monte, and Henri and Jules give up *their* land? "Liberty, *Equality*, Fraternity"—words that have blessed France many times are sometimes her curse. No, the little towns will be rebuilt where they stood or not rebuilt; and that makes both an engineering and an economic problem, neither of them easy to solve.

The English Channel Tunnel

(Continued from page 399)

government always warmly endorsed the scheme.

Hawkshaw's design called for a single double-track tunnel, the boring being 36 feet in diameter and the finished internal diameter 30 feet. Its length was to be 31 miles and its cost $40,000,000. Much study was given to the question of ventilation, which was provided for by building the tunnel with three arched air-passages formed in the solid floor of the tunnel, which was about 10 feet in depth. Ventilation was of prime importance because it was proposed to use steam locomotives. Investigation showed that, in those days (1875) the proportion of carbon dioxide in theaters was 20 to 32 parts, and in the law courts of London, 19 to 20 parts, and in a first-class carriage on the underground railway 22.5 parts, per 10,000. With 48 trains each 24 hours drawn by steam locomotives, it was estimated that the carbonic acid gas at each quarter-length of the tunnel would be 12¾ parts per 10,000 in excess of the normal quantity of 3½ parts.

Proposals to Bridge the Channel

Of the various bridges proposed, note should be made of the Boutel suspension bridge, which was to be carried upon 20 cast-iron piers extendings 460 feet above sea level.

The only plans for a bridge which were ever worked out in full detail were those of M. Schneider and H. Hersent, associated with Sir John Fowler and Sir Benjamin Baker of the Forth bridge. We present a side view of a section of this bridge, which consisted of great cantilevers, 200 feet deep and 2,025 feet in length, each canti-

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lever carried upon two piers 1,500 feet apart, and a series of suspended spans 375 feet in length carried by the cantilevers. The structure, therefore, would have consisted of alternating spans of 1,500 and 900 feet. The piers were to be built by the caisson method. The caissons, 100 feet by 250 feet in plan, were to be towed out and sunk through the overlying mud to firm bottom. The total length of the bridge was to be 24½ miles, with 118 piers and two abutment piers. Provision was made for two railroad tracks, and the total weight of steel in the whole bridge would have been 771,265 tons. The estimated cost in 1889 was $170,000,000, which means that it would cost today not far short of $300,000,000. Not merely the cost but the destructibility of a bridge renders that type of crossing out of the question.

The Present Plan

The strata at the Channel consist, commencing at the bottom, of Gault and upper green sand; the lower chalk; followed by the middle chalk and the upper chalk. The tunnel will be driven through the gray chalk which is found at a depth of 89 feet at Dover and 80 feet at Sangatte. The material is compact and impervious to water; it contains no flints, and, as far as known, has no fissures or slides. Should heavy leaks occur they could be grouted up. The chalk is remarkably free from water. There will be two main tunnels 18 feet in diameter, placed 36 feet apart, center to center. At frequent intervals they will be connected by cross-passages fitted with air-tight doors. Each tunnel will have a total length of 31 miles, including the junctions with French and British lines. The excavation will be done by shields and modern boring machines, which will be able to make rapid progress through the chalk. The excavated material will be carried back by belt conveyors to cars which will be drawn to the terminal shafts by electric locomotives. The tunnels will be iron-lined, grouted up on the outside and lined on the inside with cement concrete.

Drainage

The drainage system will consist of separate tunnels, which will tap the main tunnel at its lowest level and, diverging from the line of the tunnel, they will descend on a slope of 1 in 500 to drainage shafts located on each shore. The drainage tunnels will be 11 feet in diameter and they also will be lined with cast-iron. By the use of boring machines it is expected to make a speed of 17 yards per day for six days of the week. The ventilation will be by way of a conduit at the top of the tunnels. Air will be blown in by high-speed fans in the direction of the traffic. The estimated cost today is about $100,000,000, which will be shared equally by the British and the French.

There is no question but that the tunnel will now be built. The former British fear of invasion, never well founded, has disappeared in the presence of the close alliance of the past five years and the demonstrated value of the tunnel in the event of future joint hostilities of France and Great Britain against the common enemy. Probably construction will await the return of more normal conditions in the industrial world; but we look for the completion of this great work within a decade.

Automatic Wireless Receiver Which Anyone Can Operate

(Continued from page 403)

give successive increases in the receiving wave length, from 150 meters to about 3,500 meters on the ordinary ship's antenna. The motor may be controlled by means of a rheostat, so that the cycle of operation may be correspondingly varied. A clutch mechanism is provided in the motor drive, so that the operator may stop the mechanism at any desired point to listen to signals. The wave length of the receiver at any given moment is indicated by a round dial which moves past a pointer.

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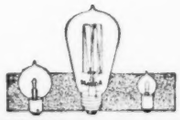

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Given an automatic receiving set, such as this one, it becomes perfectly obvious that the necessity for standard wave lengths is more or less shattered. For, no matter on what wave length a transmitter may be calling, the receiving operator is bound to pick it up in the course of his automatic receiver's cycle. At the same time this receiver greatly simplifies the work of the operator, who is no longer obliged to manipulate numerous handles and knobs incessantly in order to keep in touch with everything taking place in the ether. Indeed, it becomes possible for the layman to obtain the same results with the automatic receiving set as the most skilled professional operator.

A number of these uni-control receivers have been in use for some time, proving in every way the contentions of the designer. In fact, several of them were employed by the Signal Corps for detecting enemy wireless stations. In the case of the portable Signal Corps apparatus, a hand crank only was provided for driving the train of gears.

Exporting the Bolsheviki

(Continued from page 402)

A region in which a great industry is located is bound to become proficient in the manufacture of machinery and implements and in the perfection of processes by which that industry may be carried on.

Readjustment in the Northwest

In western Wisconsin was formerly the heart of the white pine lands, but most of the timber has been cut and the production of lumber has lost its earlier importance. Several towns have well-equipped machine shops where foreign lumbermen have come to buy logging machinery. This product of Wisconsin foundries has been employed to fit out a number of complete mills in Australia. A machine that stamps the name of the lumber manufacturer upon each board produced by his mill was invented by a man in the Northwest and seems assured of a good market in foreign countries. So the passing of the lumber industry from the region mentioned has not brought unemployment because these other industries have helped to replace it.

The prey of the Bolsheviki is the man without a job. He is ready to listen to any sort of talk if it has any bearing upon the regaining of his bread and butter. There will be plenty of work for all if American manufacturers will cast an anchor to windward by gaining new customers outside of the United States. The extension of our foreign trade is essential not only for national prosperity but for *national safety*.

Aerial Greyhounds of Tomorrow

(Continued from page 401)

to a similar mooring tower for several weeks at a time, with winds blowing up to 50 and more miles an hour, without sustaining the slightest damage.

The dirigible service will be no fair weather proposition, so we are assured. The elements of weather that have influence on airship travel are wind, rain, hail, snow and fog. It is not likely that rain, hail, snow and fog will of themselves have much influence on airship flying. With suitable rain-proof non-absorbent outer covering, the absorption of water and the consequent increase of weight are avoided. Hail and snow will not adhere to the huge hull when in flight, owing to the high speed through the air and in any case, as the precipitation height is not usually more than 8,000 feet, they can be entirely avoided by flying above this height. Fog might give trouble in landing, but in flight the airship would be above the fog and not be affected by it. In landing, suitable means would be taken to mark the landing place by means of captive balloons or kites, and strong searchlights could be used on the ground. Rain, hail, snow and fog are also generally local in their occurrence, and could in any case generally be avoided by a short deviation from route. Cross-Atlantic records indicate that on the main steamship routes fog sufficient to impede navigation does not occur more than 12 days in a year. And there is the directional wireless to fall back on, as already suggested.

The only important factor that need be taken into consideration is wind, but in most cases unduly strong winds can be avoided by flying at a higher level or sailing on a different course so as to avoid the storm area. As is well known, there are at sea level, between certain clearly-defined latitudes, prevailing winds of constant direction, of which advantage may be taken by suitably laying out the course and route to be followed. Again, at the higher levels, there is at most latitudes a constant drift, of which advantage may be taken if the winds at sea level are unfavorable. At any rate, the matter of wind is not a serious one when the navigator has so broad a medium in which to sail.

Sky Pilots for the Sky Liners

The navigation of airships is similar in principle to that of steamships, but is made more difficult by much greater drift to be allowed for. The actual course of a ship being the resultant of its own forward speed and that of the motion of the air in which it is borne, it is impossible for the navigator to plot his true course relative to the earth unless he is aware of the motion of the air. When navigating over land he is able to determine the drift of his ship by observation of a suitable fixed point on the earth's surface, and adjust his compass course accordingly to give the desired true course. Over sea, of course, no fixed point is available, so if the motion of the wind is not known, the course must be periodically corrected by astronomical observation and determination of his charted position.

A reliable and effective method of navigation is, however, available with the wireless installation. If the ship is in communication with two stations they can determine the direction of the transmitted waves and signal back the ship's bearings, from which the position can be laid off on the ship's chart and the new departure determined. It is known that this method of direction was used successfully by the German naval Zeppelin airships, throughout the four years of war but more especially during raids.

So from all that has been said, which, be it understood, is only a popular resumé of the voluminous documents and drawings of the British engineers, it is obvious that aerial transport is close at hand. Technically, aeronautical men are prepared to open airship routes to-morrow; financially, there is some question. The engineer has gone ahead and done all the planning; the constructors stand ready to execute the plans already in hand; but the capital for such a project is still to come. And it will come; for the airship must soon develop into a rapid means of travel between distant cities and countries and continents

New Industrial Uses for X-Rays

IN an address delivered before the Birmingham and Midland Scientific Society, British, on February 19th, Major Hall-Edwards stated that radiography was capable of much wider application to industry than was generally supposed to be the case. He mentioned that X-rays had already been used in connection with the examination of metal castings, and showed some radiographs of aero engines which plainly revealed defects in the internal structure of the castings. Cartridges had also been subjected to examination by means of X-rays, with the result that inequalities in the disposition of the metal sufficient seriously to affect the trajectories of the projectiles, had been discovered. Wood for airplanes had been examined with useful results, and he suggested that the investigation by means of radiography of conditions of strains, compression and bending would yield information of much importance.

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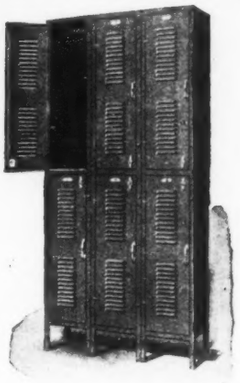

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(14307) M. C. asks: Why does the month of February contain 28 days, and when the year is Leap it contains 29 daays. Why not 30 or 31 days like other months? A. The extra day is inserted in February every four years in order that the seasons of the year may remain in the same months perpetually. Thus it will be winter in the same months and summer in the same months for thousands of years. Indeed it will remain so as long as time shall last by omitting the extra day in the even hundreds of years unless the year contains 400 without a remainder. Thus 1700, 1800 and 1900 were not Leap years, but 2000 will be a leap year. The reason for all this is that the year is not an exact number of days in length. It is 365 days, 5 hours, 48 minutes, and 46 seconds in length. The 365 days cannot be divided into 12 months of equal length. The hours, minutes and seconds increase the difficulty of making a calendar which will cover the year with no remainder. This cannot be done. Julius Caesar arranged the calendar so that January and every other month from January, that is, the odd months through the year had 31 days, and the even months had 30 days, excepting February which had 30 in leap years and 29 in other years. Thus January, March, May, July, September and November had 31 days and four years averaged 365 days, 6 hours, which was a little too much, and this excess makes it necessary to omit the extra day in even 100s as stated above. Since the time of Julius Caesar several changes have been made in the number of days in the months, till we have the present arrangement. February, however, continues to be the month which has the extra day in Leap year. You can find all this more fully given in books in the Public Library of your city. Ask the Librarian, who will be glad to get you the books from the shelves.

(14308) N. A. S. asks: Please tell me if a certain volume of any substance will weigh more at 10,000, 20,000, 30,000, 40,000 feet in the air than it does at sea-level. Is there any difference whether those weights were taken on heights of land or straight up into the air from the sea. A. The weight of all bodies due to gravity decreases as we rise above or go below the surface of the earth. Nor does it matter whether the weight is taken on a mountain side or in a balloon or airplane. It is the attraction of the earth as a whole which gives weight to a body on it. The air on the other hand buoys up all bodies as much as the air weighs which the body displaces. This buoyancy is greatest at the sea level and decreases as we ascend into the air. At about three miles we are above half the air, the buoyancy is reduced by one-half and the apparent weight is increased by the same amount. If then we had a solid so light that the decrease of its weight by gravity in going up from the earth's surface was less than the increase of its weight from the buoyancy of the air it would weigh more at a considerable altitude. We do not know any such solid.

(14309) C. W. W. asks: Would solenoids, arranged to produce a reciprocating motion of a core, controlled by an automatic reversing switch become superheated on continuous use, if windings were rated per the correct amphere turns? A. If your solenoid is designed as you describe, it will not overheat any more than any other coil which is carrying its proper current. The current which is spent in heat in a wire is the cost of carrying the current on its way, and it must be paid. It cannot be avoided.

(14310) I. M. H. asks: Will you please inform me, if possible, as to what can be added to a mixture of acetone and acetic ether, which prevents rapid evaporation when the mixture is used as a solvent of the celluloids? A. We do not know any way to prevent evaporation of a volatile liquid except to shut it tight in a jar or bottle. The free space will then become saturated with the vapor of the liquid and after that state is reached there will be no further evaporation.

(14311) B. H. asks: Is white a color? If so, please explain why it is not a color. 2. On some thermometers there is a glass tube filled with this liquid and crystals, which is supposed to indicate weather. This tube is sealed up and I do not see how the atmospheric pressure and humidity can affect the contents of the tube. How does it

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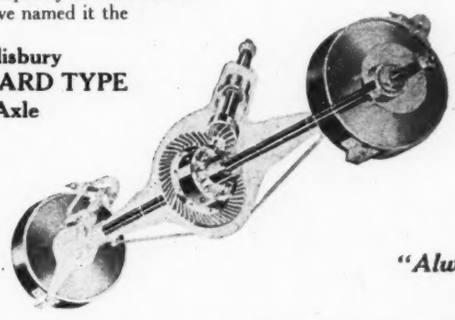

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work? A. 1. White and black are not classed as colors by artists. Black is the absence of all colors of the light. A color is a distinct hue, as for instance, green or blue. White is not a hue at all. This is the basis for the distinction in question. 2. The tube which you describe contains alcohol and more camphor than the alcohol can dissolve. The quantity dissolved varies with the temperature. It is not a barometer and shows nothing as to the changes of the weather. We heated one of these so-called "Standard Barometers" for which we paid 20 cents (!) till nearly all the camphor had dissolved and then cooled it to about 40 degrees and the entire tube showed solid camphor up to the very top. What could such an affair show as to the weather and rain or snow.

NEW BOOKS, ETC.

PRACTICAL PHYSIOLOGICAL CHEMISTRY. By Philip B. Hawk, M.S., Ph.D. Philadelphia: P. Blakiston's Son and Co., 1918. 8vo.; 661 pp.; 185 figures; 6 color plates. Price, $3.50 net.

Brought up to date by thorough revision, this widely used text for schools of medicine and science has increased its usefulness. On the clinically important subject of acidosis a new chapter is introduced. The treatment of metabolism, blood analysis, gastric digestion, and the quantitative analysis of urine is expanded, and the last-named follows Van Slyke's procedure to the exclusion of former methods. Modern apparatus is fully illustrated, the selection and preparation of the charts and colored plates is beyond criticism, and the subject of physiological chemistry is adequately presented in its multiform aspects.

THE GASOLINE AUTOMOBILE. Its Design and Construction. Vol. III. Electrical Equipment. By P. M. Heldt, Member Society of Automotive Engineers. Nyack, N. Y.: P. M. Heldt, 1918. 8vo.; 410 pp.: illustrated. Price $3.50.

The first volume of this set dealt with the gasoline motor, the second with transmission, running gear and control; this third volume completes the series by a comprehensive study of the electrical equipment, with notes on its maintenance, care and repair. Like the preceding volumes, it addresses itself to the needs of the student and engineer; but it is also a practical handbook for the managers and employees of garages and service stations, and includes a treatment of the elementary principles of electricity. Particular attention is given to care and maintenance, and remedies are always accompanied by reasons. The information is throughout full, practical, and well presented; the book satisfactorily completes a noteworthy set.

ADVERTISE. By E. Sampson. New York: D. C. Heath and Co., 1918. 8vo.; 247 pp.; illustrated.

The author holds advertising to be the solution of the reconstruction problem, and in this text for teachers and students he unfolds the principles of the art, clarifies its strategy, and presents numerous pictorial examples. To pass the acid test, an advertisement must get inside the skin of the prospect—must take his point of view: it must avoid the common-place, appeal to the eye, and make a suggestion that acts dynamically upon the recipient. All these considerations are well presented, and the advertising letter, the follow-up, books and folders, and other forms of publicity are concisely dealt with.

THE LIFE AND DISCOVERIES OF MICHAEL FARADAY. By J. A. Crowther, Sc.D. New York: The Macmillan Company, 1918. 8vo.; 72 pp.; portrait. Price, $1.

This is a straightforward narrative of the life and life work of the great English chemist. The reader is given a glimpse of his boyhood, a sketch of his early training, and a rather full description of his electrical researches. The freshness and enthusiasm of Faraday's own character pervade the pages, and the little book fills a worthy niche in the "Men of Science" series.

LES AVIONS ALLEMANDS, ZEPPELINS ET MOTEURS. By Jean Lagorgette. Paris: Ed. Blondel La Rougery, 1918. 240 pp.; 450 illustrations. Price, 15 Fr.

The author of this work is a specialist in the subject with which it deals: he does not confine himself to vague general descriptions, but covers in detail enemy airplanes and dirigibles, their motors, armament, etc. It not only comprises an exposition that is of interest to flyers and mechanics, but one that also has its appeal to designers and engineers. It shows graphically the great efforts made by Germany in her fight for command of the air, and is particularly designed to stimulate and inform the military constructors and airmen of the Allies. The descriptions, with their profusion of designs and photographs, deal with practically all the important types that bore enemy emblems during the war.

HEROES OF AVIATION. By Laurence La Tourette Driggs. Boston: Little, Brown and Company. 8vo.; 301 pp.; illustrated from photographs. Price, $1.50 net.

For the first time, the most dramatic episodes in the lives of the Allied flyers are told, and told well, in a single volume. For the first time, too, appears the full story of the American Lafayette Escadrille, which included our own Lufbery. The work of Guynemer's "Storks," France's crack escadrille, is graphically detailed. The exploits of more than a score of the Allied conquerors of the air, among them Lieutenant Thieffry of Belgium, Major Baracca of Italy, and Colonel Bishop, the British ace of aces, are narrated in simple but impressive language. Then there is a list of the aces of all nations and their victories.

LOANS AND DISCOUNTS. New York and Chicago: A. W. Shaw Company. 8vo.; 264 pp.; illustrated; charts, etc. Price, $3 net.

The Shaw Banking Series would be incomplete without a book on the important subject of loans and discounts. The questions that harry both the large and the small banker are considered and answered. The most thorough and at the same time least expensive methods of handling the loan are concisely sketched; routine work is simplified, and the charts and forms offered are valuable acquisitions for any banker, for instead of being the products of abstract ingenuity they are the tested results of practical usage. The adoption of the suggestions given cannot but mean a larger margin of profit from the safe loan.

HINDU ACHIEVEMENTS IN EXACT SCIENCE. By Benoy Kumar Sarkar. New York: Longmans, Green and Co., 1918. 8vo.; 82 pp. Price, $1 net.

This brief but embracing account presents India as the greatest manufacturing and commercial power of antiquity, with a wide knowledge of industrial chemistry, a great skill in metal-working, and expertness in the preparation of fast dyes. The various chapters chronicle the discoveries and progress of mathematics, physics, chemistry, medicine and natural history, each claim being referred to a long bibliography of significant works: the book also brings out certain relations, chronological and logical, between Hindu investigations and those of the Greeks, Chinese and Saracens.

THE ENGLISH OF MILITARY COMMUNICATIONS. By William A. Ganoe, Major of Infantry, U. S. A. Menasha, Wis.: George Banta Publishing Company, 1918. 8vo.; 200 pp.

Very little reflection will demonstrate the necessity for terse, exact expression in military communications. "Careless wording," as Major Ganoe says, "like careless shooting, is not only ineffective but often suicidal." The book bears witness to the fact that the author has himself mastered the subtleties of the English language; it puts the student in the way of shaping his thought into exact words and phrases that cannot be misinterpreted even by the most stupid. The field order, written and verbal, is studied in all its bearings, field messages, official correspondence, reports and lectures, receives most careful consideration, and the work abounds in practical problems and exercises.

DEMOCRACY VERSUS AUTOCRACY. A comparative Study of Governments in the World War. By Karl Frederick Geiser, Ph.D. New York: D. C. Heath and Co., 1918. 12mo.; 94 pp. Price, 60 cents.

While this little treatise was especially prepared to meet Government requirements in the War Aims Courses given in colleges and universities, it is admirably adapted to the needs of the busy general reader. It clarifies such vague terms as "democracy," "autocracy," and "self-determination," and draws its examples from the foreign nations in this war. The work forms a very concise study of political ideals and types of institutions, and conveys information that is certainly greatly needed before we can intelligently grapple with present problems.

BOYS' BOOK OF CHEMISTRY. By Charles Ramsay Clarke. New York: E. P. Dutton and Company, 1918. 8vo.; 265 pp.; illustrated. Price, $2 net.

There are few boys who would not be interested in mixing two chemicals together and getting a substance quite unlike either as a result, or in resolving a compound into its original elements by light, heat, or electricity. The author presents a very good assortment of easy and safe experiments for which the young reader is taught to construct his own apparatus; these are accompanied by a simple explanation of up-to-date chemistry, with profuse illustrations. Chemistry is a field of wonderful promise for brain and ambition, and the work should be instrumental in guiding many boys into a profitable and absorbing vocation.

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